

SHIP MONITORING SERVICE
SIMONS

01-12-2015

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Ship Monitoring Service

GMV SECURITY EXPERIENCE



GMV: SECURITY BACKGROUND

GMV experience in the security domain lasts for almost 10 years



SUPPORT TO EU EXTERNAL ACTIONS

- Overview/Detailed topo-information
- Identify belligerent actions
- Tracking exodus
- Contingency plans
- Evacuation & rapid reaction
- Post conflict recovery



INFRASTRUCTURE PROTECTION

- Civil critical infrastructure: pipeline, airports, ports, industrial sites, depots, dams, roads...
- Critical geographic elements
- Digital maps
- MGCP GDB
- Strategic briefing reports



MARITIME SURVEILLANCE

- Vessel detection & categorization
- Law verification
- Tracking large volumes of vessel position information
- Integrate EO + AIS
- Port monitoring
- Coastal crime
- Suspicious ship track
- Oil spills
- NRT traffic control



LAND BORDER SURVEILLANCE

- Overview/Detailed topo-information
- Identify treaties transgressors
- Illegal human trafficking
- Illegal infrastructures
- Automatic intrusion detection

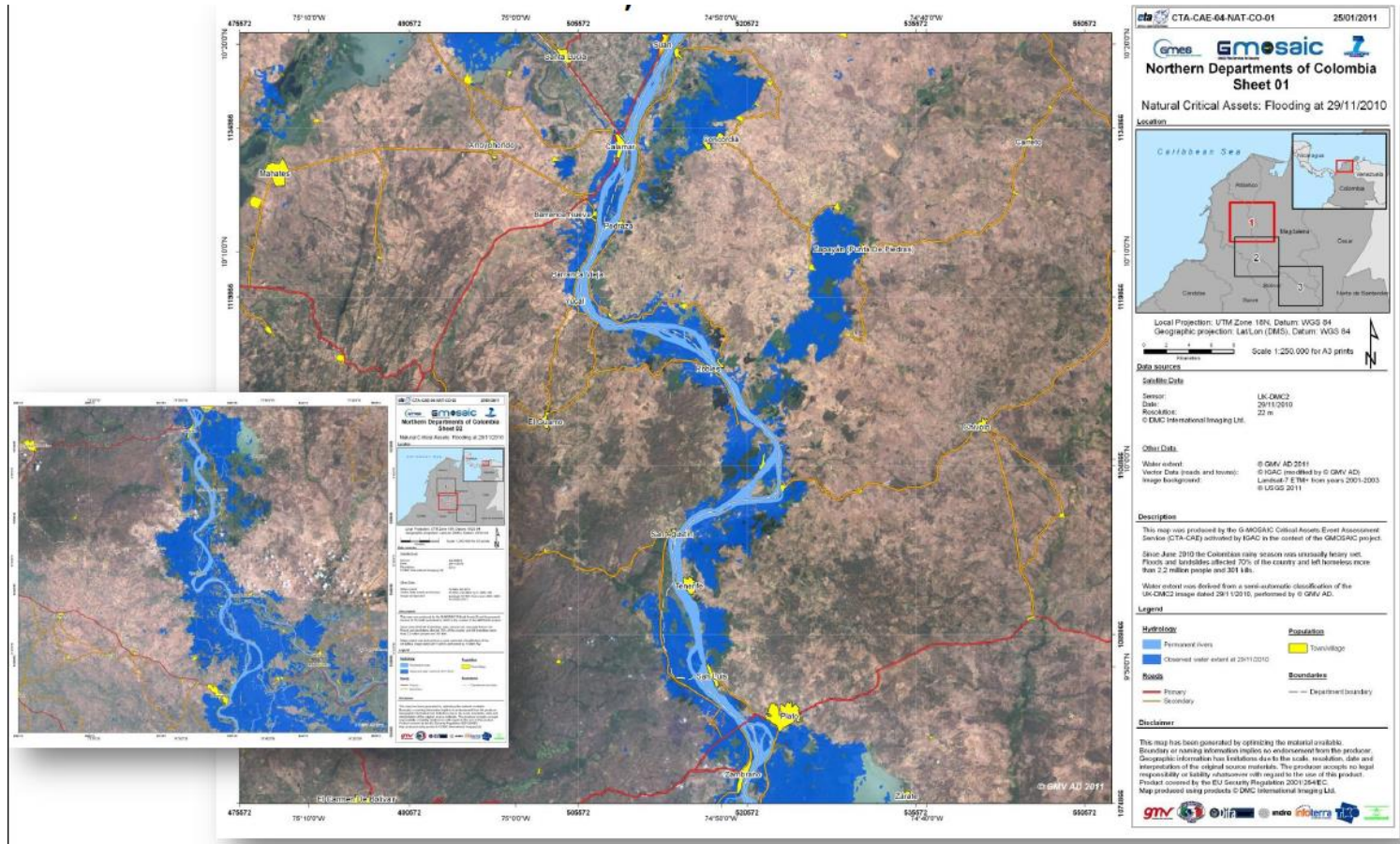
GMV: SECURITY BACKGROUND

EU EXTERNAL ACTIONS: Contingency planning during the Arab Spring 2011 in Benghazi, Libya



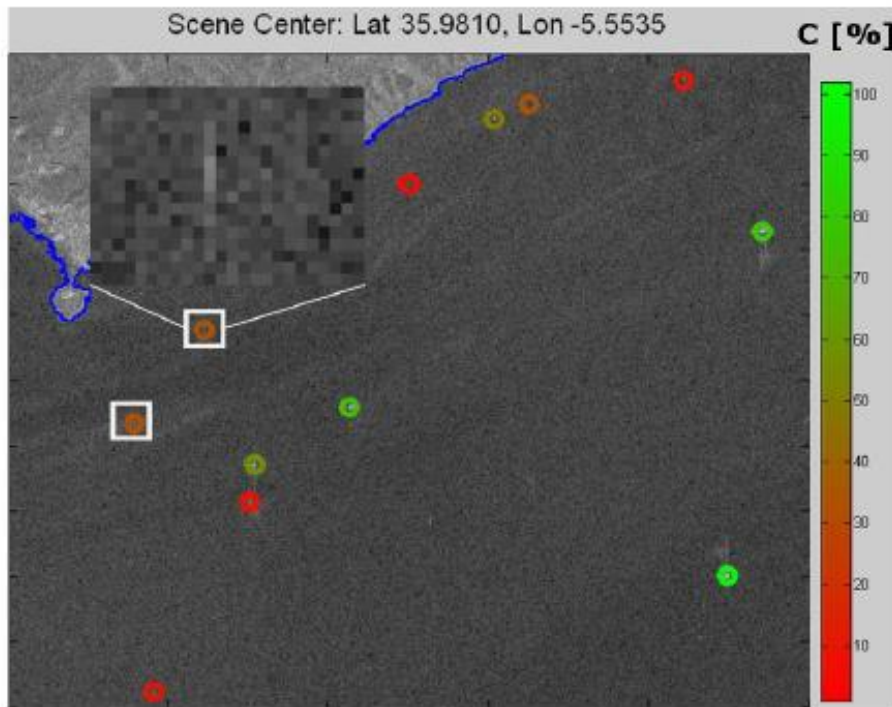
GMV: SECURITY BACKGROUND

INFRASTRUCTURE PROTECTION: La Niña induced flood events in Colombia



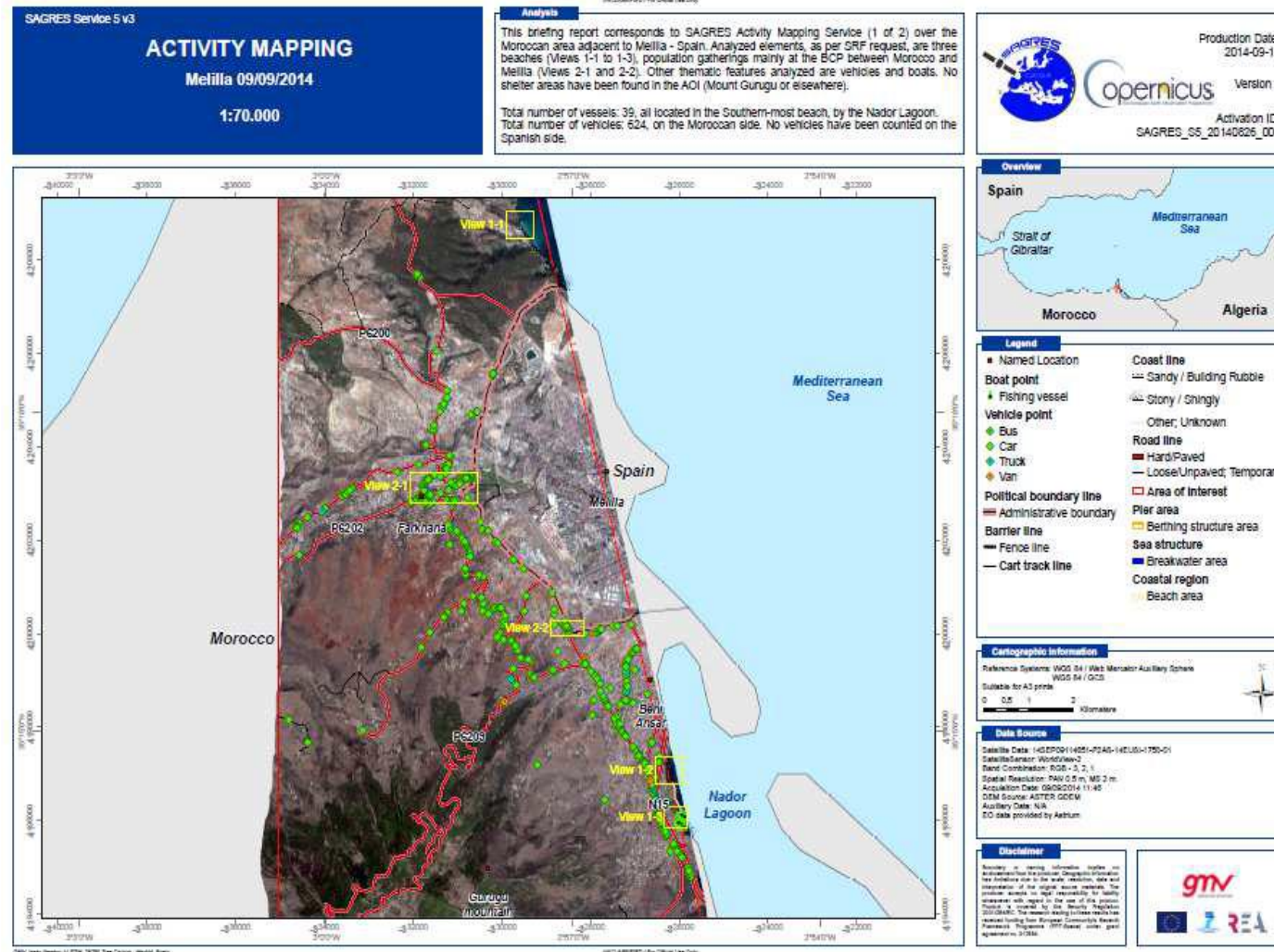
GMV: SECURITY BACKGROUND

MARITIME SURVEILLANCE: target monitoring based on SAR and optic image processing



GMV: SECURITY BACKGROUND

LAND BORDER: Pre-frontier products



GMV: SECURITY BACKGROUND

GMV extrapolates the security experience to emergency response



PREPAREDNESS

- Support to emergency response units
- Reference digital maps
- Reference GDB

- Honduras
- Botswana
- Colombia
- Haiti
- Indonesia
- Philippines

CRISIS REACTION

- Rapid mapping

- Moscow pipeline explosion
- Haiti earthquake
- Chile earthquake
- Toxic cloud simulation Tunis
- Colombian floods
- Arab Spring movements

RELIEF

- Recovery follow up
- Verification of investments
- MGCP digital maps and eodatabases
- Support for emergency units, decision and policy makers

GMV: SECURITY BACKGROUND

Main Customers

- EC
- Frontex
- SATCEN
- EMSA
- ESA
- Guardia Civil
- IHI (Japan)
- INTA
- Telespazio Ibérica
- C-CORE (Canada)

Main Users

- Guardia Nacional Republicana
- Italian Coast Guard
- EFCA
- Universities & Research Centres

Ship Monitoring Service

GMV MARITIME EXPERIENCE



GMV: MARITIME BACKGROUND

GMV experience in the maritime domain lasts for almost 10 years

| PROJECT | PRIME | FOUNDER | TIME | BUDGET |
|----------|-------|------------------------------|---|--------------|
| MARISS | NO | ESA'S GSE | 2005-2012 distributed in 3 phases | ~ 20 M€ |
| EMSA-DFM | YES | EMSA | 2011-2012 | 51k€+16,5 k€ |
| NEREIDS | YES | EC'S GMES FP7 | 2011-2014 | ~ 6 M€ |
| SAGRES | YES | EC'S GMES FP7 | 2013-2014 | ~ 4 M€ |
| LOBOS | NO | EC'S GMES FP7 | 2013-2014 | ~ 4 M€ |
| CAPSAT | YES | GUARDIA CIVIL through EBF | 2015 | ~ 400 K€ |

Different collaborations with EU agencies and national authorities:

- MISA-EM project of MNE6 lead by US Joint Forces Command
- West Africa coast test with USCG
- INDALO with EMSA and Guardia Civil

GMV: MARITIME BACKGROUND

GMV has participated in several projects / initiatives within the maritime domain

- ✓ **MARISS: MARitime Security Service** funded by ESA's GMES Service Element (GSE) from 2005 to 2012.
 - ✓ Prime: Telespazio with 16 partners distributes across Europe
 - ✓ Pan-European service network
 - ✓ 3 phases: Phase 3 from 2009-2012 for fully operational service provision
 - ✓ **GMV was the national service provider of Spain.** Users:
 - ✓ Spanish Army
 - ✓ Guardia Civil

GMV: MARITIME BACKGROUND

GMV has participated in several projects / initiatives within the maritime domain

- ✓ EMSA-DFM: Data Fusion Module founded by EMSA from 2011 to 2012.
 - ✓ Prime: GMV
 - ✓ Develop a data fusion module to complement the services available in IMDATE
 - ✓ 2 phases: Phase 1 at 2011 and Phase 2 (CCN) at 2012
 - ✓ **GMV was the service developed and provider:**
 - ✓ Capability to process single entries in < 1 s
 - ✓ Integration into IMDATE

GMV: MARITIME BACKGROUND

GMV has participated in several projects / initiatives within the maritime domain

- ✓ NEREIDS: New Service Capabilities for Integrated and Advanced Maritime Surveillance
 - ✓ Prime: GMV with 16 partners distributes across Europe
 - ✓ R+D tasks to improve current performance of MSA
 - ✓ Fully operational campaigns involving user assets
 - ✓ Users:
 - ✓ Spanish Army, Guardia Civil, GNR, ITCG, EFCA, Spanish tax agency
- ✓ GMV developed tasks of campaign coordinator and service provider in ship detection and categorization, data fusion, track generation, system implementation and maintenance

GMV: MARITIME BACKGROUND

GMV has participated in several projects / initiatives within the maritime domain

- ✓ SAGRES: Service Activations for GRowing Eurosur Success funded by EC's GMES (Copernicus) FP7 program from 2013 to 2014.
 - ✓ Prime: GMV with 16 partners distributes across Europe
 - ✓ Pre-operational validation of high-time critical CONOPS
 - ✓ Fully operational campaigns involving user assets
 - ✓ Users:
 - ✓ Frontex gathering NCC requests
 - ✓ GMV developed tasks of campaign coordinator and service provider in ship detection, ship categorization, track generation, system implementation and maintenance

GMV: MARITIME BACKGROUND

GMV has participated in several projects / initiatives within the maritime domain

- ✓ LOBOS: LOW time critical BOrder Surveillance funded by EC's GMES (Copernicus) FP7 program from 2013 to 2014.
 - ✓ Prime: AIRBUS with 16 partners distributes across Europe
 - ✓ Pre-operational validation of low-time critical CONOPS
 - ✓ Fully operational campaigns involving image analysis
 - ✓ Users:
 - ✓ Frontex gathering NCC requests
- ✓ GMV developed tasks of requirement coordinator and service provider in image analysis and interpretation

GMV: MARITIME BACKGROUND

GMV has participated in several projects / initiatives within the maritime domain

- ✓ CAPSAT: Providing Satellite-based surveillance capabilities through EC's EBF (European Border Funds) program at 2015.
 - ✓ Prime: GMV is the unique contractor
 - ✓ Installation of an operational system (HW and SW) providing EO-based ship surveillance services
 - ✓ Prepared to support the INDALO campaigns in the Mediterranean Sea
 - ✓ Users:
 - ✓ Guardia Civil, GNR, ITCG
 - ✓ GMV developed tasks of system implementation and maintenance, and of service provider in ship detection, ship categorization, track generation

GMV: MARITIME BACKGROUND

GMV has participated in several projects / initiatives within the maritime domain

| PROJECT | PRIME | TASK | OUTPUT |
|----------|-------|---------------------------------------|---|
| MARISS | NO | Service provider Campaign coordin. | Complete maritime monitoring service |
| EMSA-DFM | YES | Service Developer | Data Fusion Module |
| NEREIDS | YES | Service Provider Campaign coordin. | Maritime monitoring service with external HMI |
| SAGRES | YES | Service provider Campaign coordin. | Maritime monitoring products |
| LOBOS | NO | Service provider | Border monitoring products |
| CAPSAT | YES | System and service provider | Operational maritime monitoring service (HW/SW) |

GMV: MARITIME BACKGROUND

MARISS:

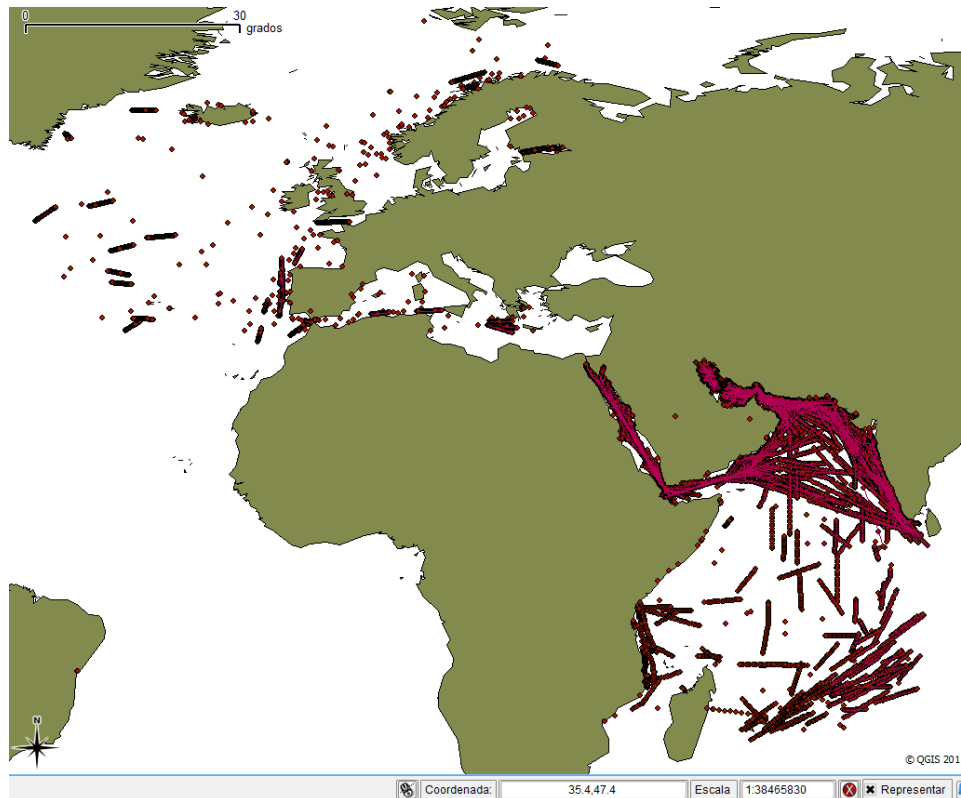
- Fully system design and implementation from dB to HMI
- Ship detection and categorization, Ship tracking and alarm triggering

The screenshot displays the MARISS web interface. At the top left is the GMV logo with the tagline 'INNOVATING SOLUTIONS'. To its right is the 'MARISS' title. Below this is a navigation menu with tabs for 'Products', 'Areas of Interest', 'Alarms', 'Reports', and 'Coverages'. The main area is a map of the Azores archipelago, showing numerous colored ship tracks and individual vessel icons. A 'Product List' window is open at the top left of the map. On the right side, there is a 'Tools' panel with a 'Filter AIS' button and a 'Filter Features' section. The 'Filter Features' section includes 'AIS Attributes' with dropdown menus for MMSI, Length, Breadth, SOG, Destination, and Name, each followed by a text input field. Below this is a 'Time Interval' section with radio buttons for 'Last Hour', 'Last Day', and 'Custom Dates'. A scale bar at the bottom left indicates 20 km and 10 mi. The map's coordinates are shown as -8.85662, 37.08309.

GMV: MARITIME BACKGROUND

EMSA-DFM:

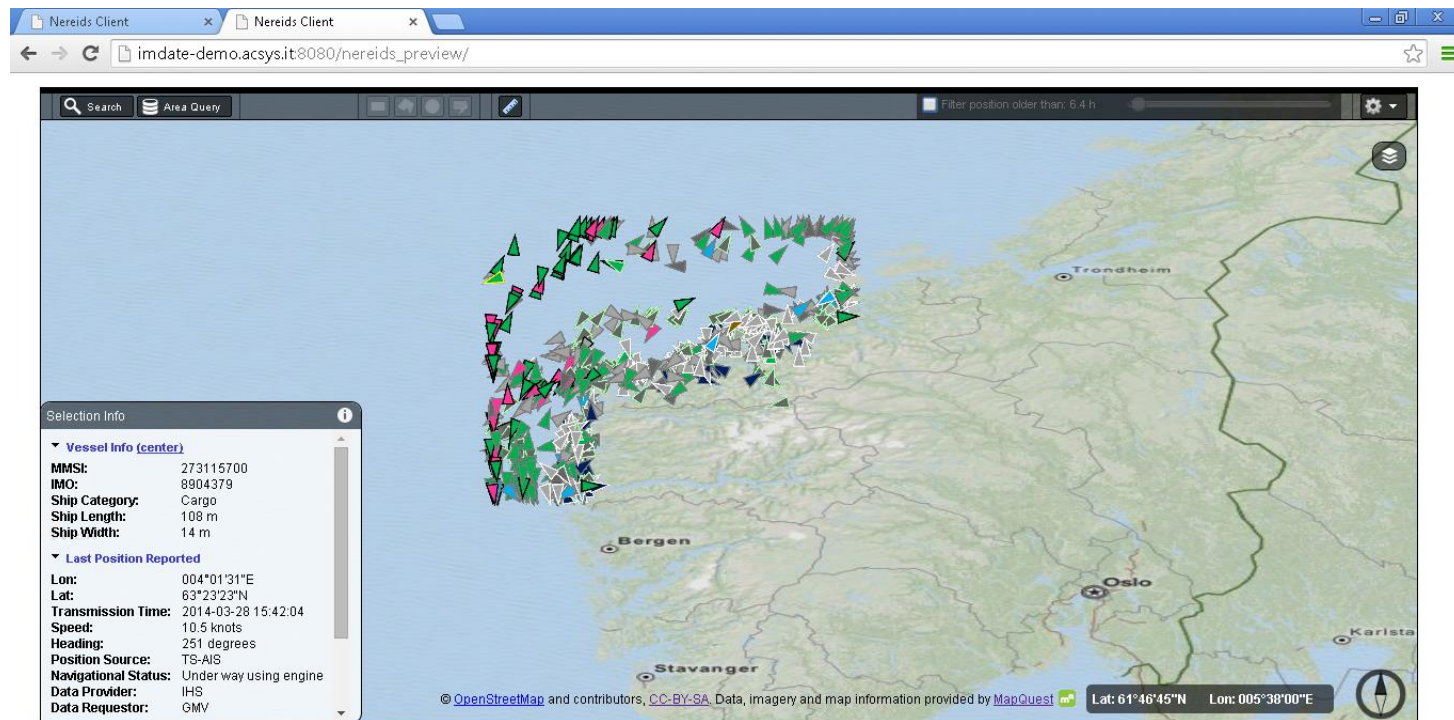
- Fully design and implementation of DFM
- Successful tests in pre-operational environment with the real IMDATE feed



GMV: MARITIME BACKGROUND

NEREIDS:

- Fully system design. Implementation from dB to data publication
- Geographically distributed processing modules
- Ship detection and categorization, Ship tracking, anomaly detection



GMV: MARITIME BACKGROUND

SAGRES:

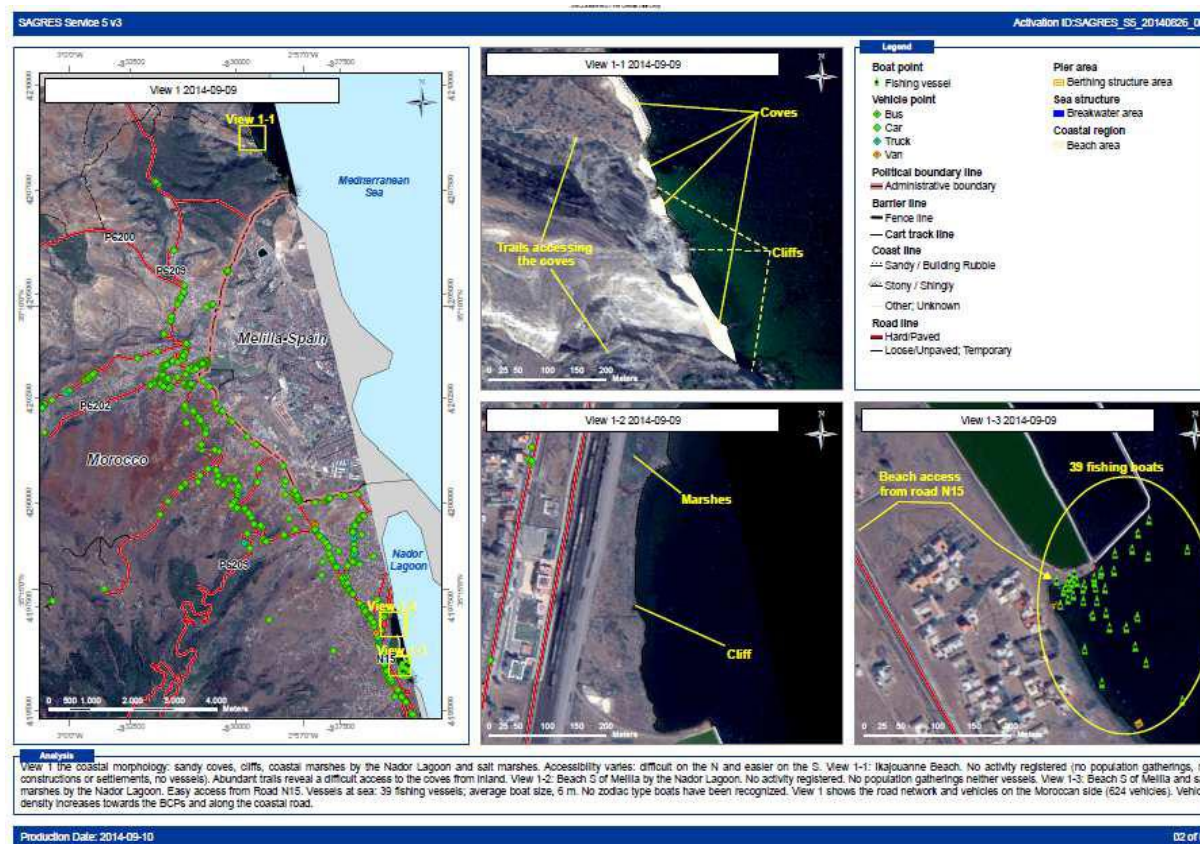
- Fully system design. Implementation from dB to data publication
- Geographically distributed processing modules
- Ship detection and categorization, Ship tracking, anomaly detection



GMV: MARITIME BACKGROUND

LOBOS:

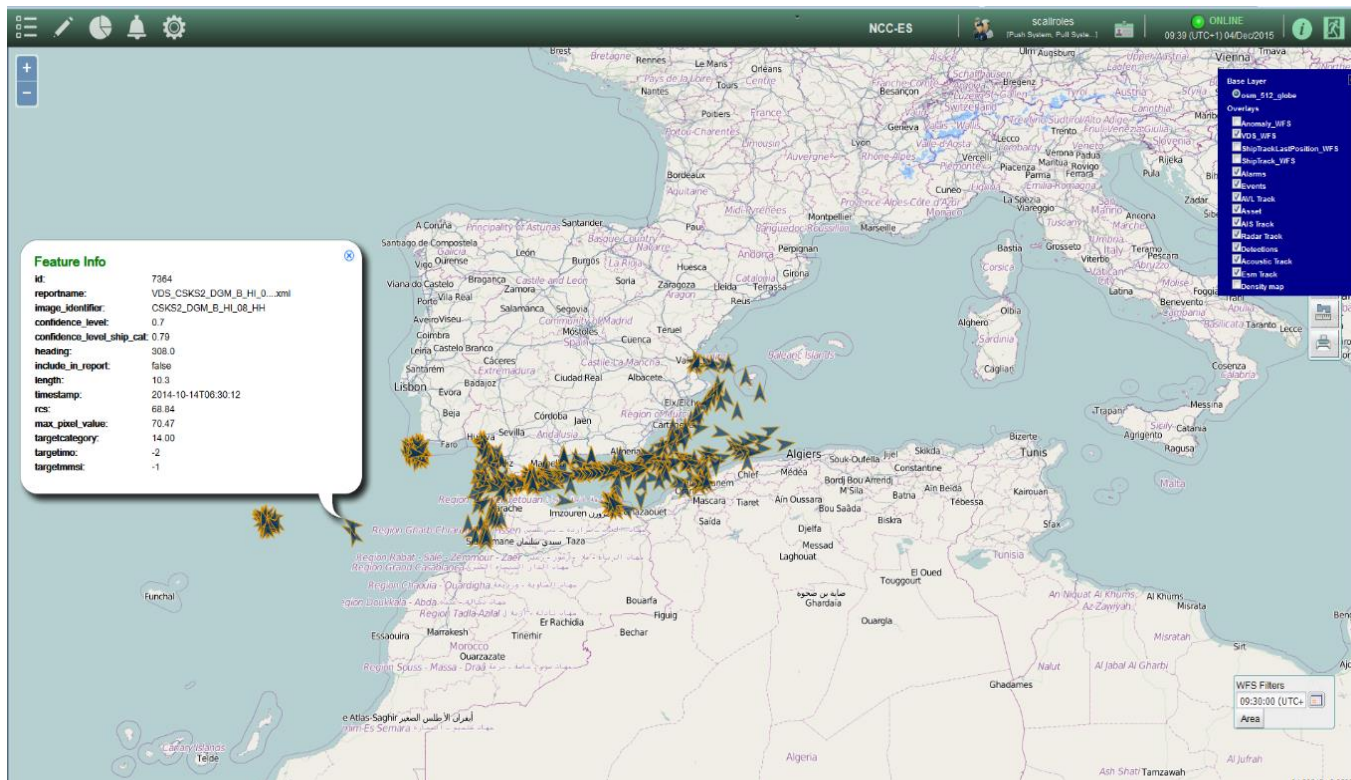
- Fully design of the processing chain
- Manual interpretation of data in high-time critical conditions
- Pre-frontier products and emergency / security assessment



GMV: MARITIME BACKGROUND

CAPSAT:

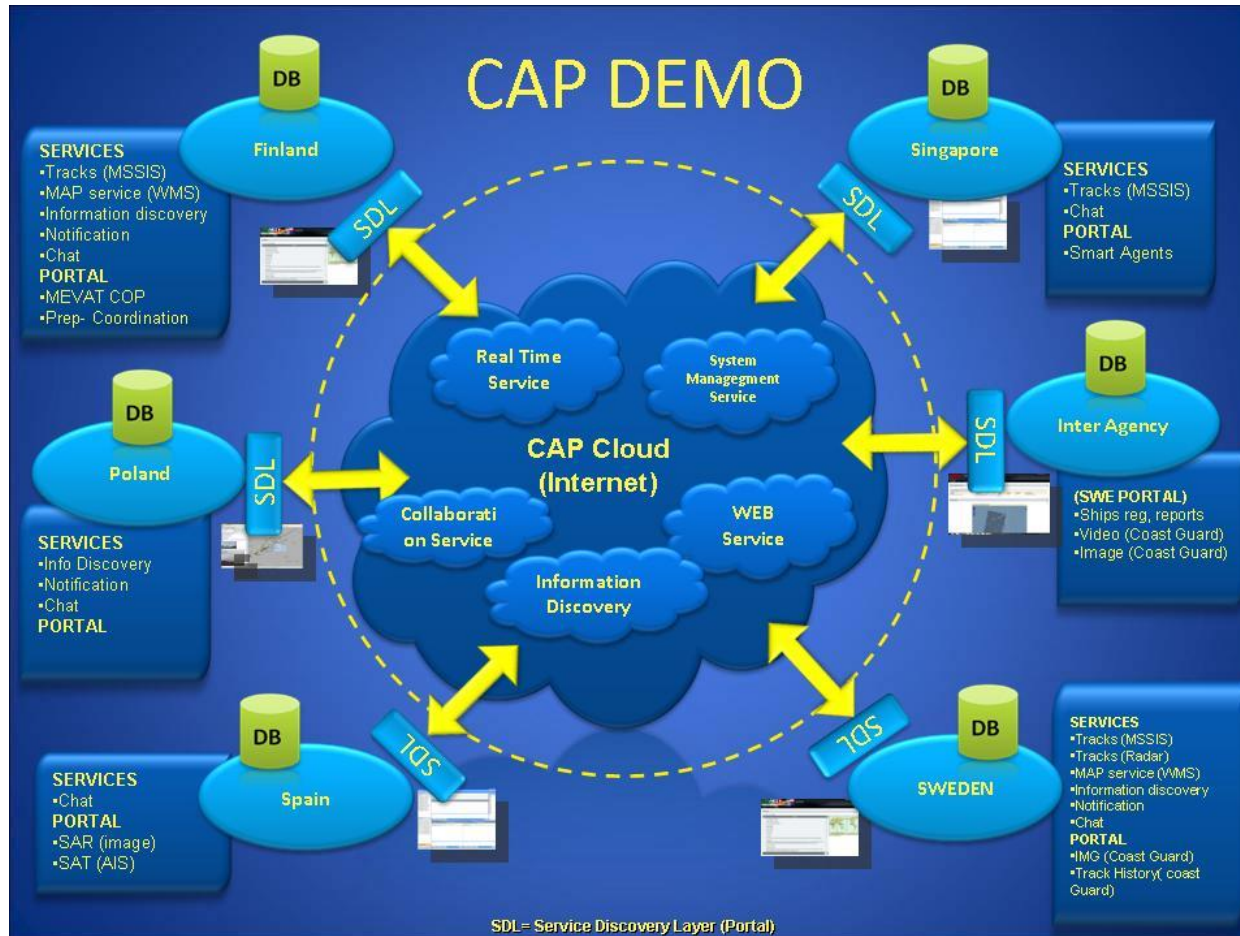
- Fully system design and implementation (HW, SW)
- Geographically distributed processing modules
- Ship detection and categorization, Ship tracking, anomaly detection



GMV: MARITIME BACKGROUND

MISA-EM from MNE6:

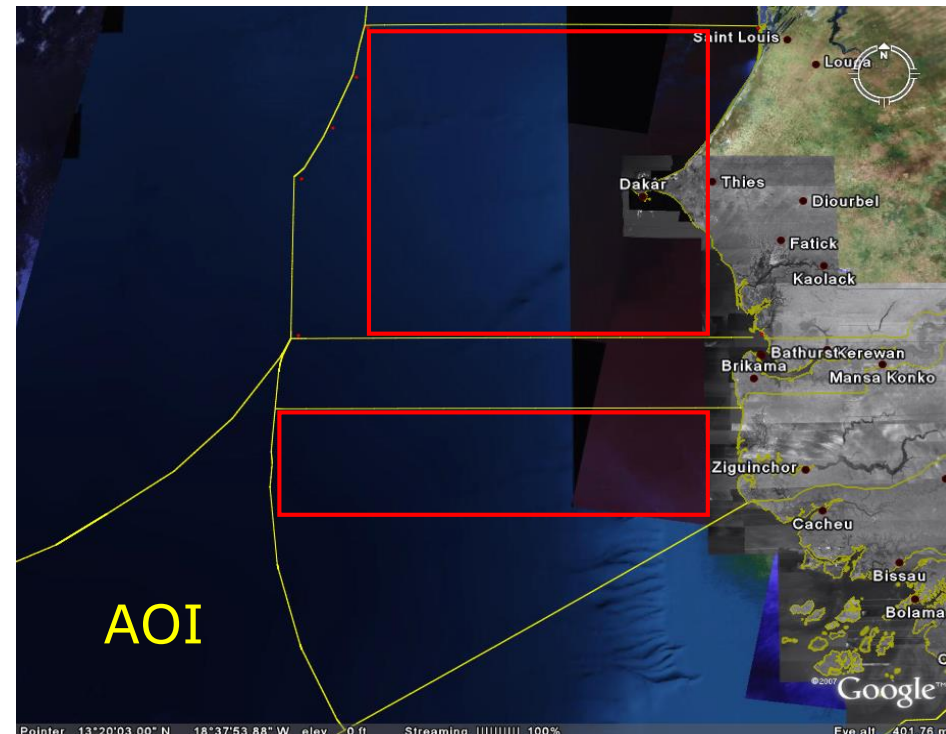
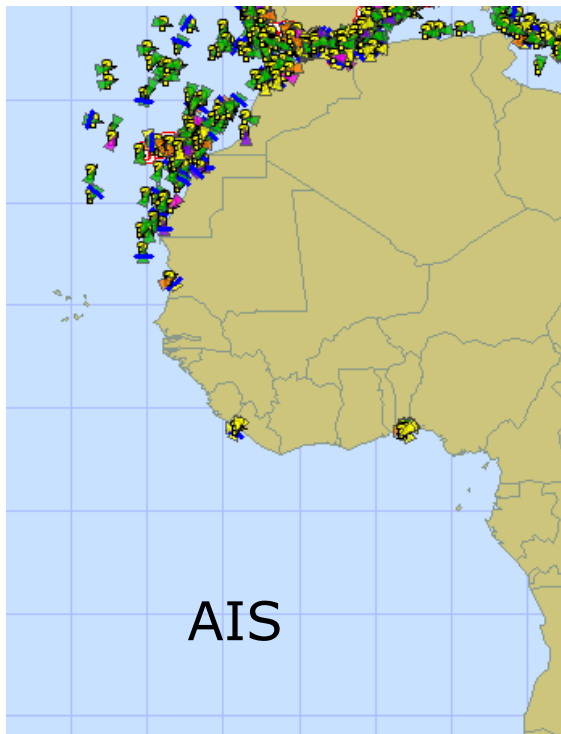
- Inter-country experiment emulating an emergency situation
- GMV provides SAT imagery based ship detection through SN



GMV: MARITIME BACKGROUND

West Africa Coast USCG experiment:

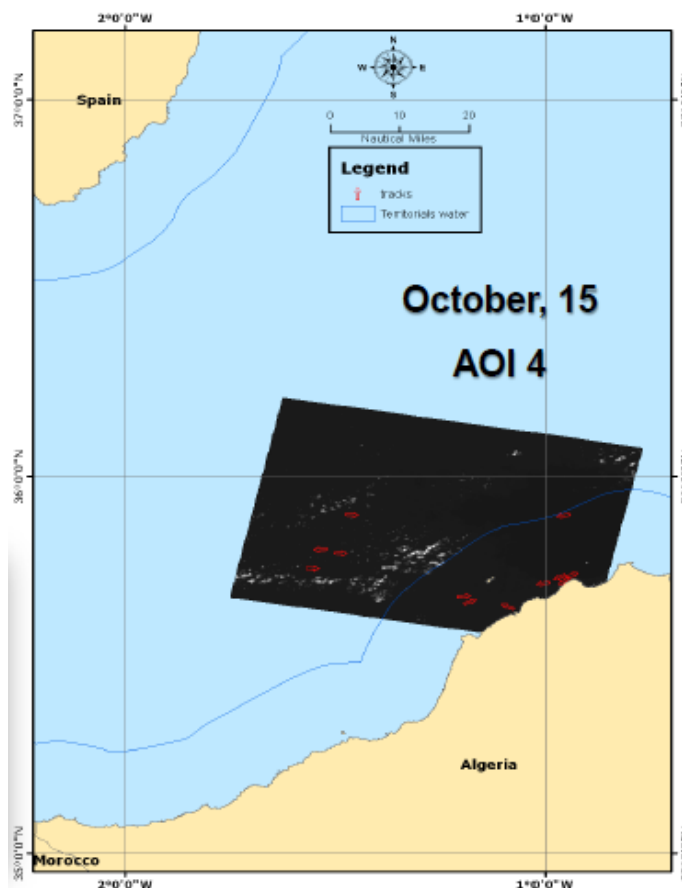
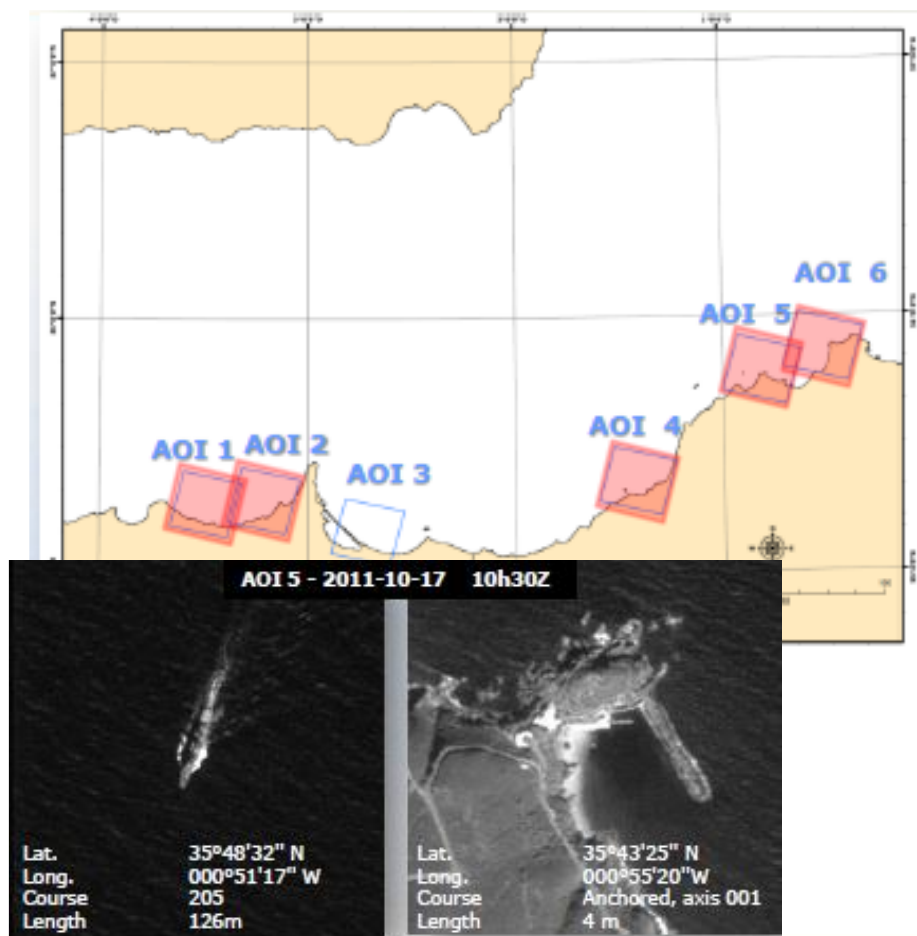
- Europe-US collaboration through MARISS
- GMV coordinated the experiment and was a service provider jointly with DLR and EGEOS. Service delivery to USCG ship was tricky



GMV: MARITIME BACKGROUND

INDALO experiment:

- EMSA-MARISS collaboration through MARISS
- GMV was a optic-based service provider



GMV REFERENCES ON MARITIME SURVEILLANCE

Main campaigns where SIMONS has been used

* The detection of potential Targets of Interest (ToI) derived on operational missions of patrolling means to confirm SIMONS results and/or to intercept / rescue the ToI

| Time | Place | User | Domain | Results |
|-----------|---------------------|-------------------------------|------------------------|---|
| 2007-2009 | Strait of Gibraltar | Spanish Navy Guardia Civil | Fishery Immigration | Pattern monitoring |
| 2009 | West Africa | USCG | Piracy | Monitoring of ToI |
| 2010 | Baltic Sea | MNE6, ≠ navy forces | Smuggling | Monitoring of a test exercise |
| 2010 | Alboran Sea | Guardia Civil (INDALO) | Immigration | Operational mission support |
| 2011-2012 | Strait of Gibraltar | Spanish Navy | Traffic monitoring | Pattern monitoring Detection of ToI* |

GMV REFERENCES ON MARITIME SURVEILLANCE

Main campaigns where SIMONS has been used

*ToI was a 4 m rubber boat moving at different speeds. Detection rate > 70%

** The detection of potential ToI derived on operational missions of patrolling means to confirm SIMONS results and/or to intercept / rescue the ToI

| Time | Place | User | Domain | Results |
|------|------------------------|------------------------------|---------------------|--|
| 2013 | West Africa | ITCG, Spanish Navy | Piracy Traffic Mon. | Detection of ToI Pattern Mon. |
| 2013 | Central Med | ITCG, Spanish Fishing Agency | Immigration Fishery | Traffic monitoring Pattern detection |
| 2013 | Algarve, PT | GNR | Validation | Detection of ToI* |
| 2013 | Morocco | Guardia Civil | Immigration | Border monitoring of immigration camps |
| 2013 | Atlantic Spanish coast | Agencia Tributaria | Smuggling | Detection of ToI |
| 2013 | Strait of Gibraltar | Spanish Navy | Traffic monitoring | Pattern monitoring Detection of ToI** |

GMV REFERENCES ON MARITIME SURVEILLANCE

Main campaigns where SIMONS has been used

* The results of this campaign based the definition of a service portfolio that Frontex has adopted in the operational phase that will start during 2015

| Time | Place | User | Domain | Results |
|------|-------------|--------------------------|-------------|-------------------------------|
| 2013 | Morocco | Guardia Civil Frontex | Immigration | Border immigration monitoring |
| 2013 | Eastern Med | Frontex | Immigration | Pattern detection* |

GMV REFERENCES ON MARITIME SURVEILLANCE

Main campaigns where SIMONS has been used

* The information was used to start investigations for law verification

**ToI was a 4 m rubber boat moving at different speeds. Detection rate > 70%

*** The detection of potential ToI derived on operational missions of patrolling means to confirm SIMONS results and/or to intercept / rescue the ToI

| Time | Place | User | Domain | Results |
|------|------------------------|---------------------------------|-------------------------|---|
| 2014 | Alesund, NO | EFCA | Traffic Mon. Fishery | Pattern Detection* |
| 2014 | Central Med | ITCG, Spanish Fishing Agency | Immigration Fishery | Traffic monitoring Pattern detection |
| 2014 | Algarve, PT | GNR | Validation | Detection of ToI** |
| 2014 | NAFO (without AIS) | EFCA | Fishery | Iceberg monitoring Law verification |
| 2014 | Strait of Gibraltar | Spanish Navy | Traffic monitoring | Pattern monitoring Detection of ToI*** |

GMV REFERENCES ON MARITIME SURVEILLANCE

Main campaigns where SIMONS has been used

* The results of this campaign based the definition of a service portfolio that Frontex has adopted in the operational phase that will start during 2015

** A ship with 38 in-stress immigrants was detected with SIMONS. The ship was under Search and Rescue operation after an emergency call. EO imagery + SIMONS permitted a notably reduction of the searching area easing the work of the in-situ patrolling means. The ship was 7 m long and the engines were out of order. The ship was detected 14,5 NM away from the reported position, which was delivered to authorities 2h 30 min after image acquisition

| Time | Place | User | Domain | Results |
|------|---------------------|---------------------|--------------------|---|
| 2014 | Greek-Turkey border | Frontex | Immigration | Detection of ToI Border immigration monitoring Pattern detection* |
| 2014 | Alboran Sea | Frontex | Immigration | Detection of ToI** |
| 2014 | Strait of Malacca | Singapur Government | Traffic monitoring | Traffic monitoring and validation results |

GMV REFERENCES ON MARITIME SURVEILLANCE

Main campaigns where SIMONS has been used

* Blind categorization exercise executed with TerraSAR-X and Cosmo-Skymed images over the Tokyo Bay area. GMV processed images with no further information about the scene and the final customer validated the results with AIS and in-situ surveillance video-camera. The results showed a detection rate larger than 90% and a categorization rate close to 86% for a 3 m stripmap. The categorization rate scaled up to close to 100% for a 1m spotlight image.

| Time | Place | User | Domain | Results |
|------|-----------|------------------|----------|--|
| 2015 | Tokyo Bay | Japanese Partner | Military | Categorization of ToI Detection of ToI* |

Ship Monitoring Service

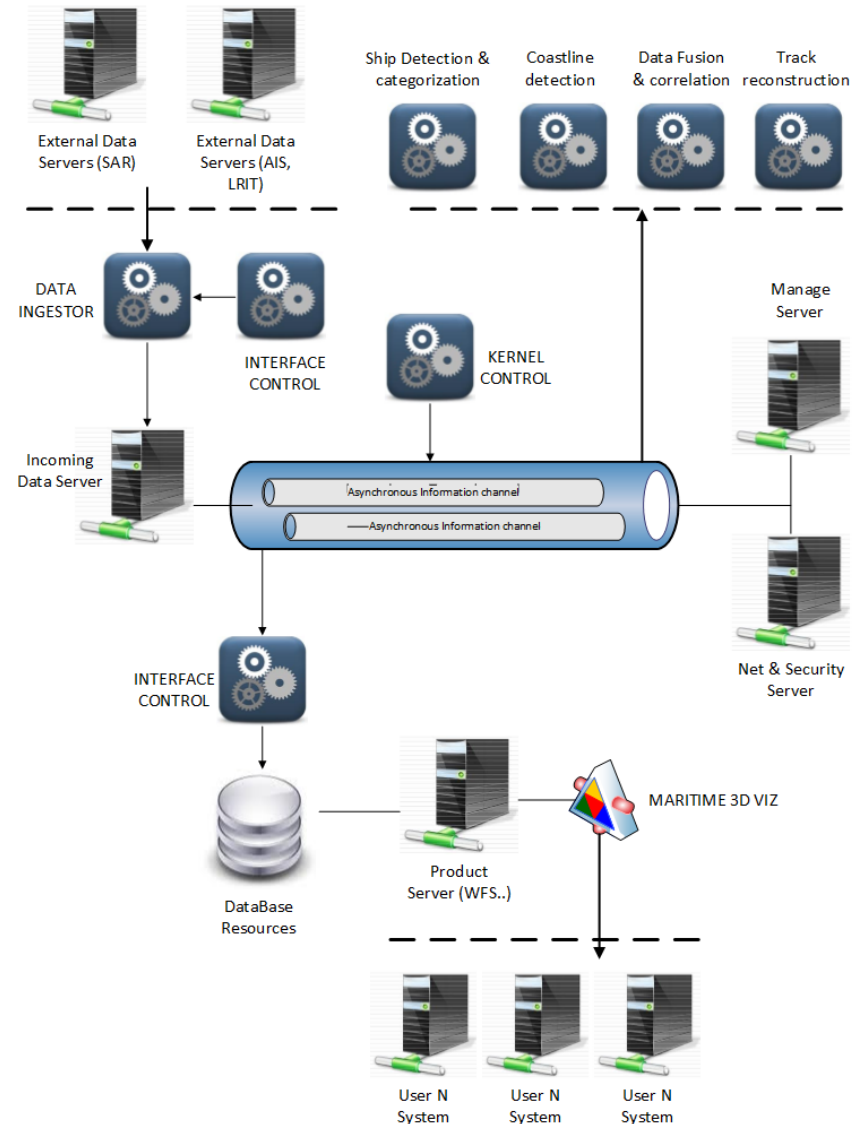
SYSTEM ARCHITECTURE



SIMONS: SYSTEM ARCHITECTURE

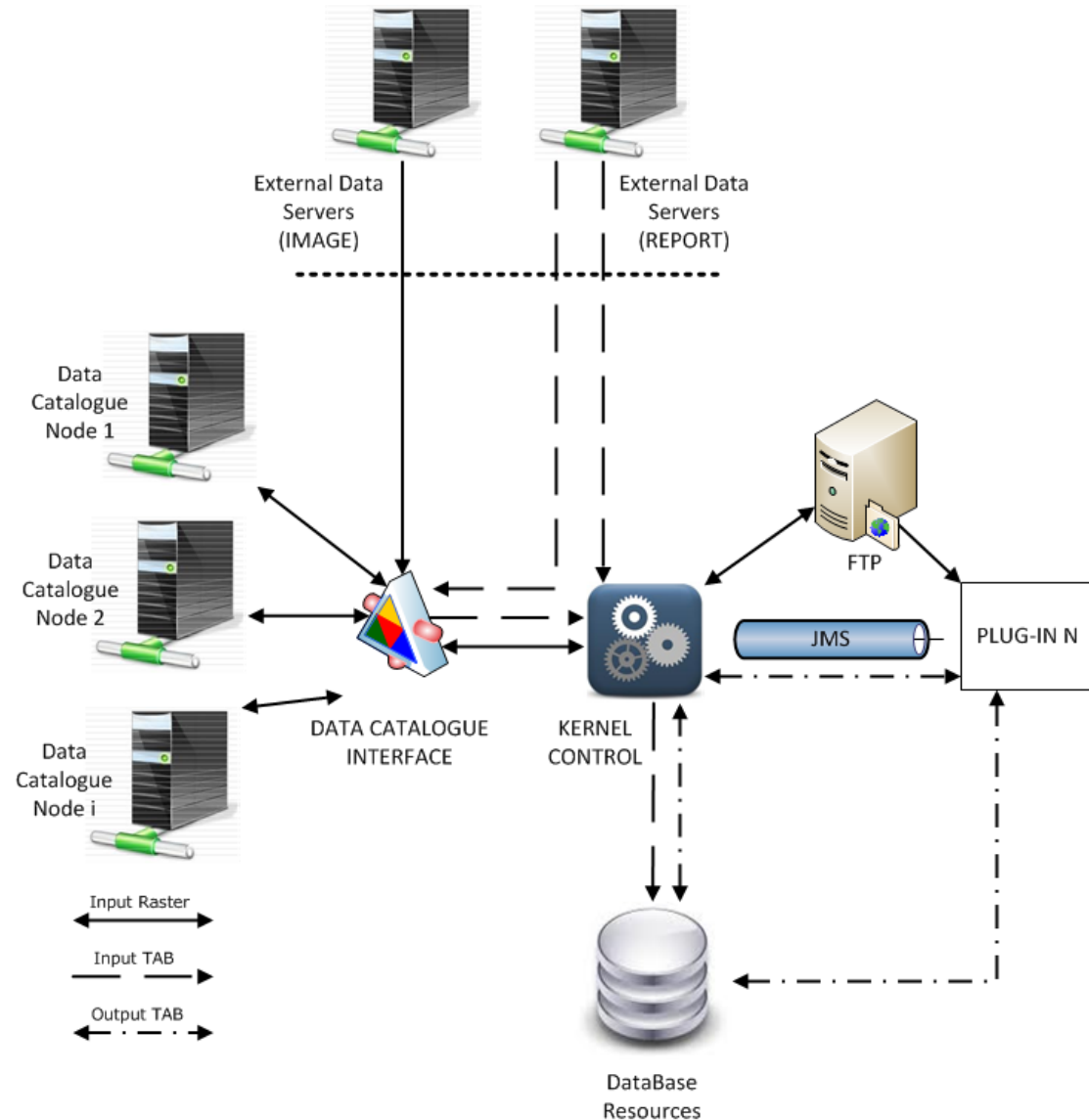
SERVICE ORIENTED ARCHITECTURE (SOA) CONCEPTS

- ✓ Geographically distributed modules;
- ✓ Kernel with DB, management and security functions;
- ✓ Visualisation and publication outside the platform;
- ✓ Automatic update of all the information.



SYSTEM ARCHITECTURE: DATA FLOW

- ✓ Open-source standard for DB, postgres with postgis;
- ✓ Open-source standard for data publication, OGC WFS and WMS;
- ✓ Standard internal data format, XML format compliant with EMSA SafeSeaNet;

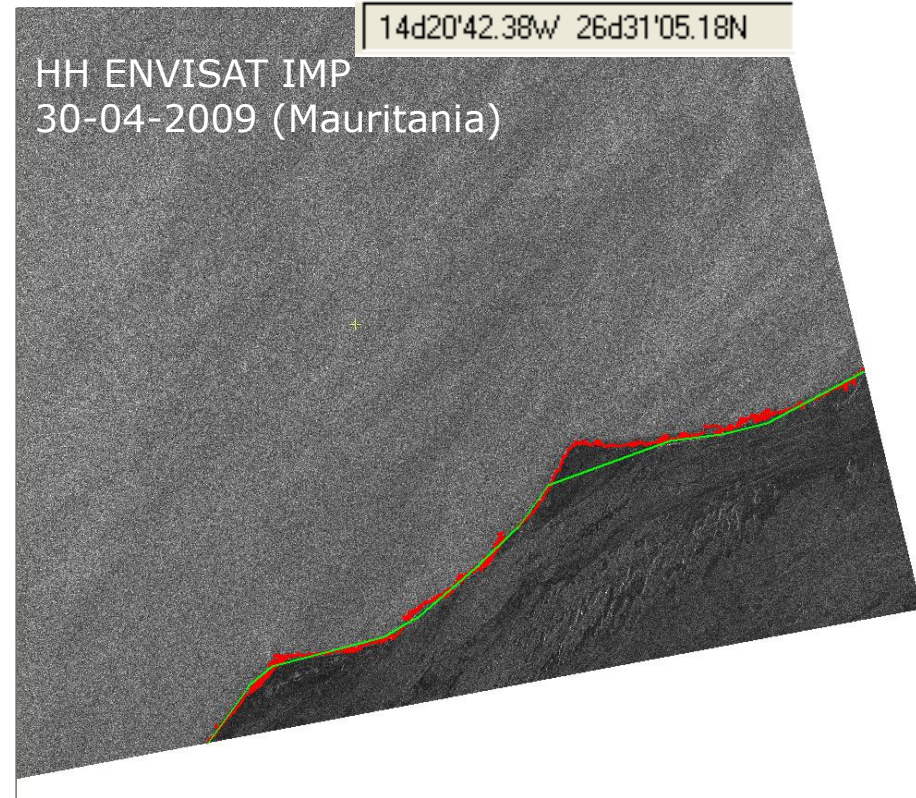
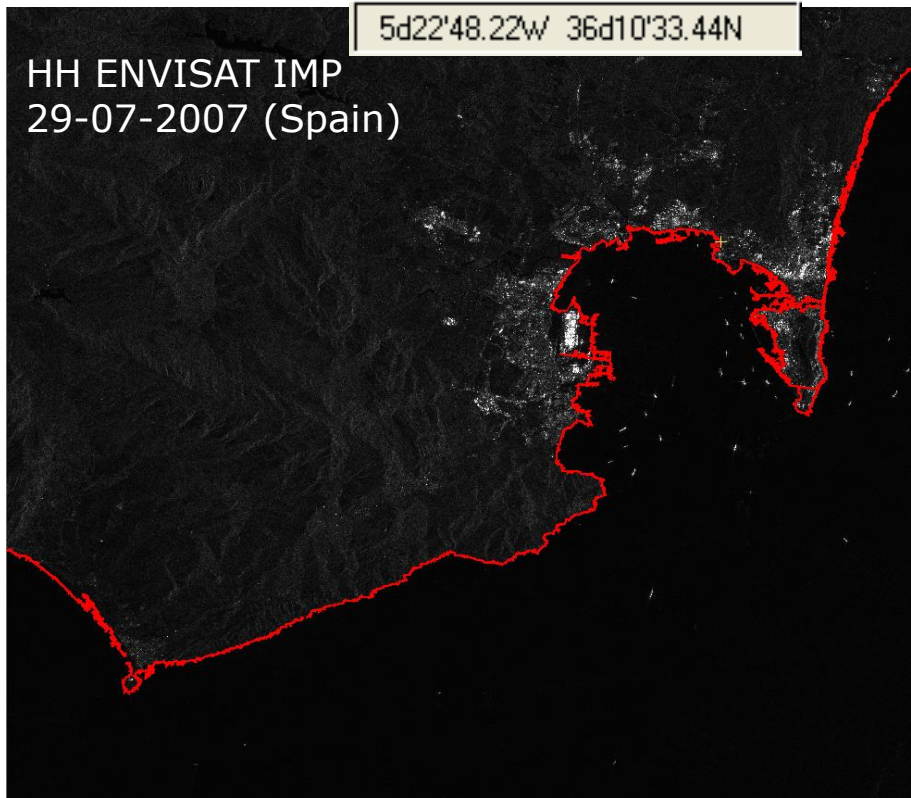


Ship Monitoring Service

EO IMAGE PROCESSING MODULES

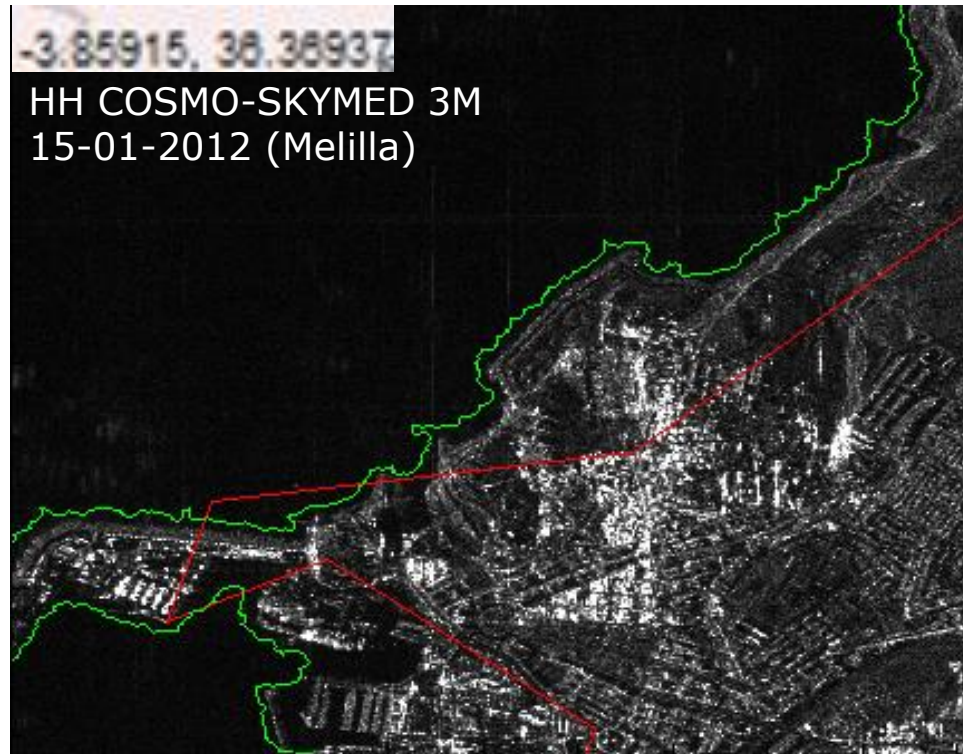


PROCESSING MODULES: LAND MASKING



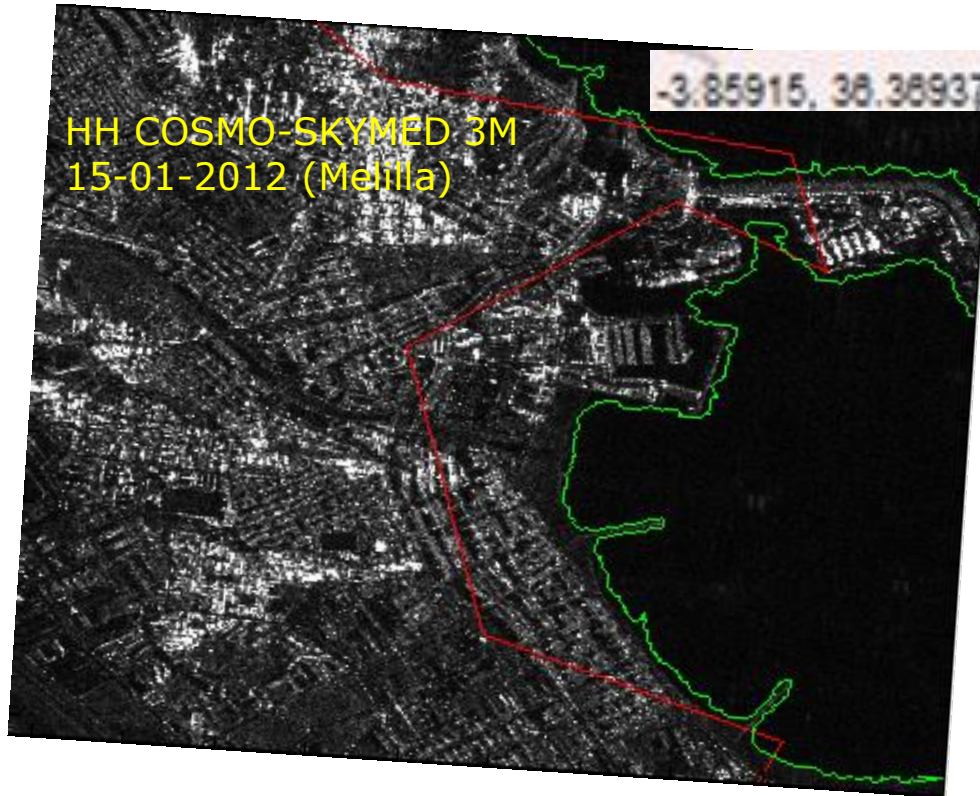
- LAND MASKING
 - Wavelet + Geodesic Active Contours
 - Usage of external shape files (if properly accurate).

PROCESSING MODULES: LAND MASKING



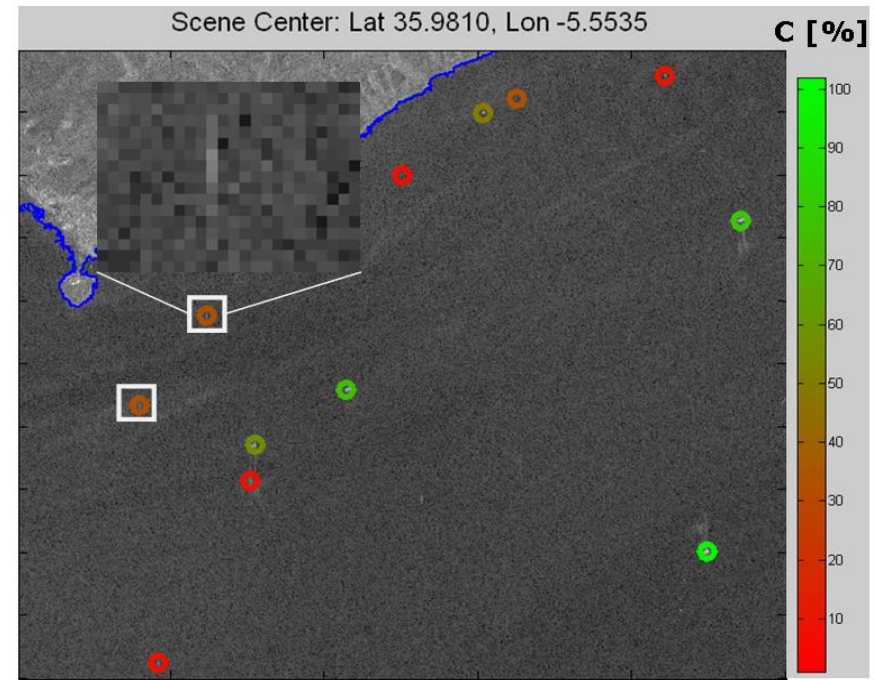
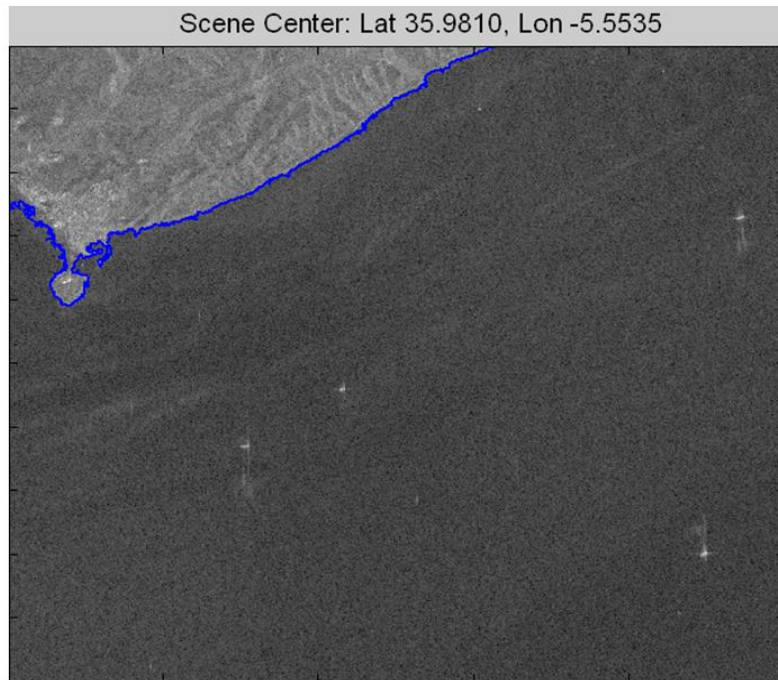
- LAND MASKING
 - Wavelet + Geodesic Active Contours
 - Usage of external shape files (if properly accurate).

PROCESSING MODULES: LAND MASKING



- LAND MASKING
 - Wavelet + Geodesic Active Contours
 - Usage of external shape files (if properly accurate).

PROCESSING MODULES: SHIP DETECTION

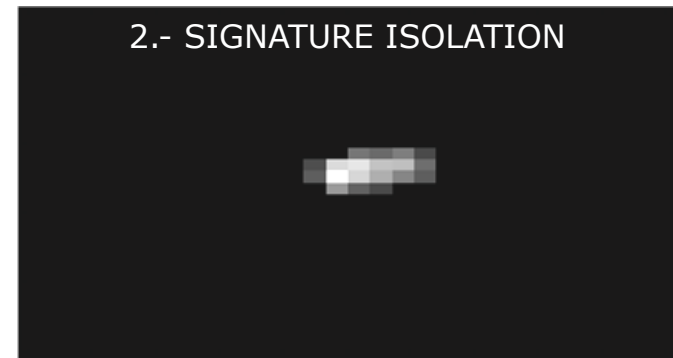


- SHIP DETECTION
 - Wavelet analysis for SAR and Segmentation for Optical
 - Confidence to quantitatively measure detection reliability.
 - $C < 0.4 \rightarrow$ ship-alike sea features (wave crests)
 - $0.4 < C < 0.7 \rightarrow$ less dispersive ships
 - $C > 0.7 \rightarrow$ ships visible by eye inspection.

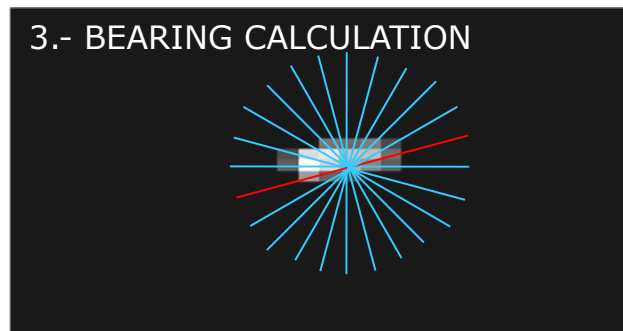
PROCESSING MODULES: SHIP CATEGORIZATION



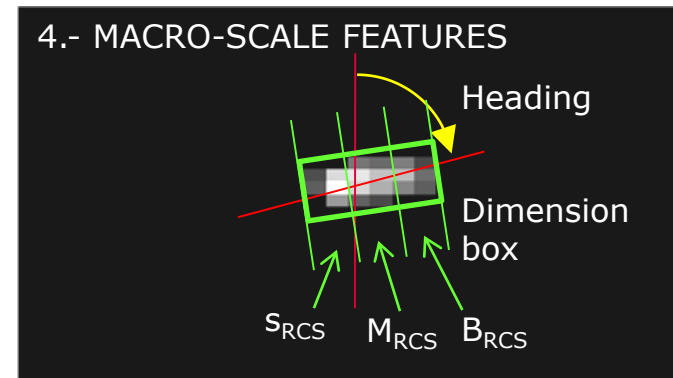
Geodesic Active
Contours



Radon
Transform



Rotation and pixel
counting



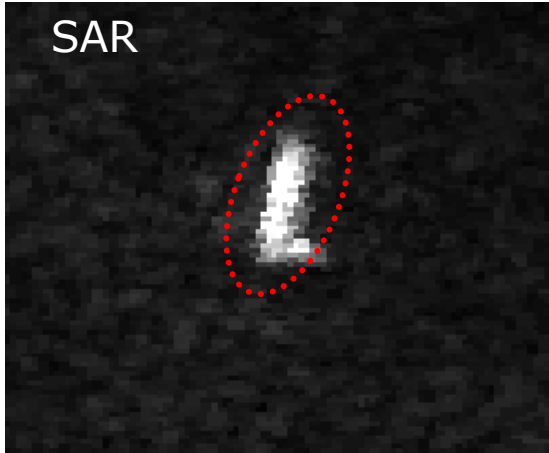

- SHIP CLASSIFICATION

5.- PARAMETRIZATION

$$P = \{B_{RCS}, M_{RCS}, S_{RCS}, L, B\}$$

6 .- FUZZY LOGIC BASED RULE APPLIANCE

PROCESSING MODULES: SHIP CATEGORIZATION

| Stena Poseidon | | | |
|----------------|---|----------------|--|
| SAR |  | ✓ | Photo |
| | | |  |
| Bulk | Bulk | Stena Poseidon | <input checked="" type="checkbox"/> |

- SHIP CLASSIFICATION
 - Validation with AIS polls

Ship Monitoring Service

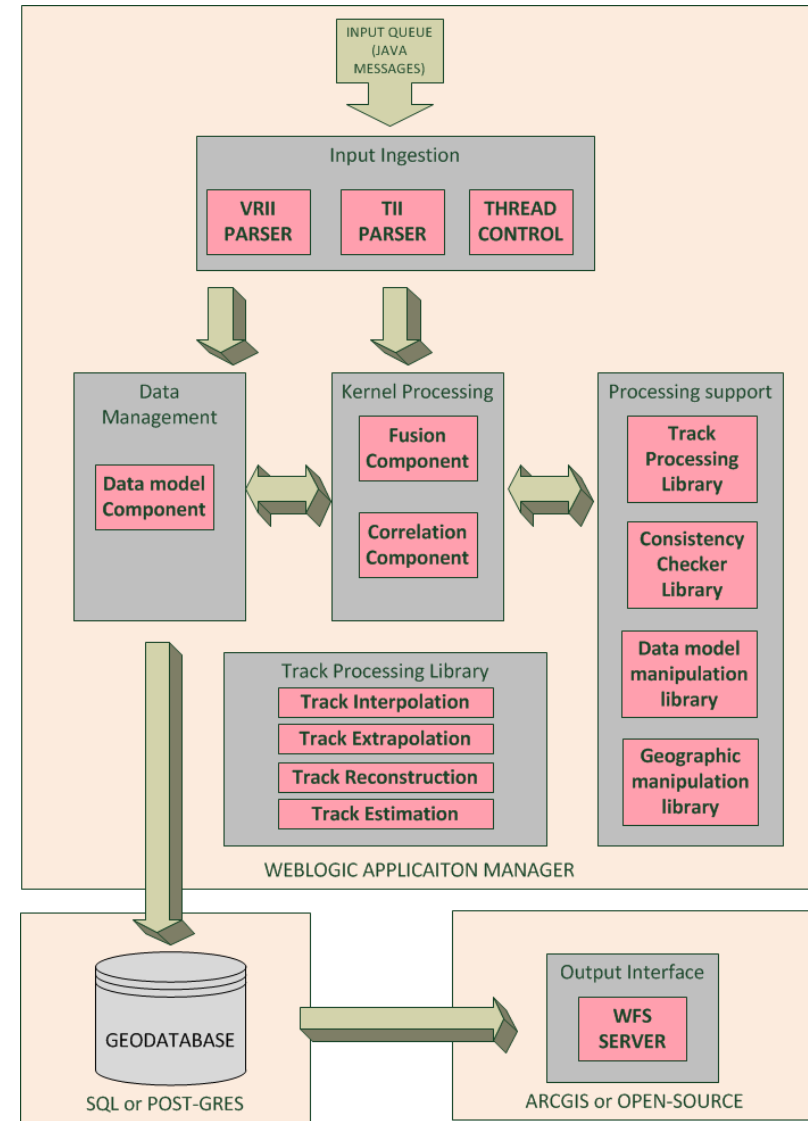
DATA FUSION



DATA FUSION

A Data Fusion Module (DFM) has been developed for European Maritime Safety Agency (EMSA):

- Fully programmed in Java
- Independent libraries available for specific features
 - Target Correlation
 - Consistency Checker
 - Track reconstruction with constraint avoidance (coastline, corridor...)
 - Track Interpolation
 - Track Extrapolation
- Environment flexibility
 - PostGRES (PostGIS) + MapServer / GeoServer
 - Oracle + ArcGIS

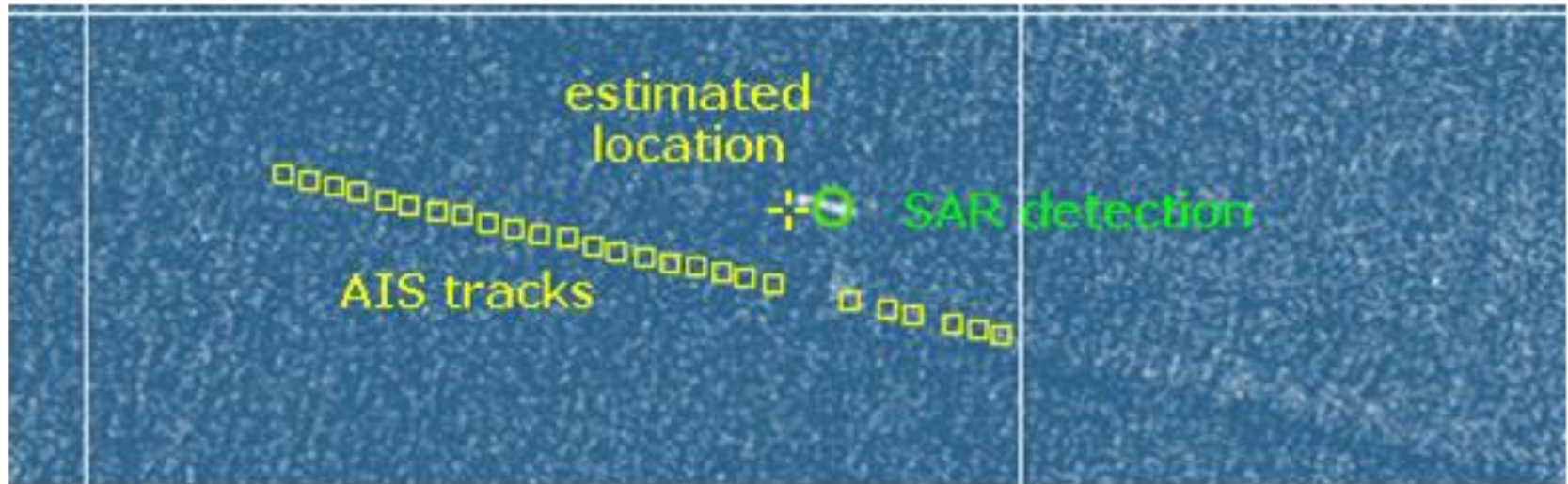


DATA FUSION

DFM performance:

- Processing time **< 1 second per entry**
 - Mean value for all functions (reconstruction, interpolation, extrapolation)
 - Independent of database contents and operations.
- **Two buffers** are used to store in local memory part of DB. This speeds processing time up
 - Immediate buffer: for those entries maximum 1 day old
 - Historic buffer: for those entries maximum 7 days old
- Processing capability in one journey (Gulf of Aden)
 - Data reported from an area of 30x30° would be processed
 - 15K new entries ingested
 - 60k track sections are generated / modified
 - 3k new tracks are generated

COOPERATIVE-VDS CORRELATION



- Fuzzy Logic based approach
- Data formats: AIS, LRIT, VMS, S-AIS...
- Pre-processing
 - Doppler shift and slant-range projection compensation

Ship Monitoring Service

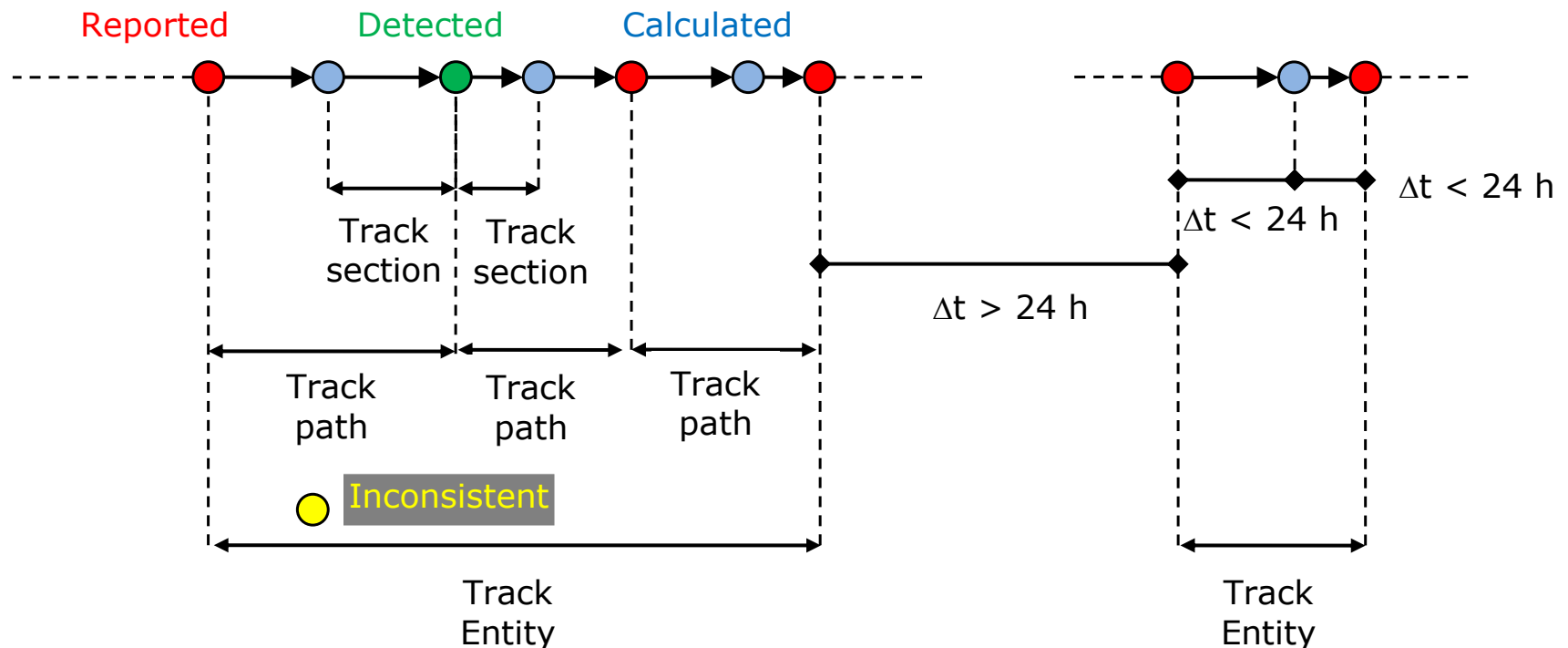
TRACK RECONSTRUCTION



TRACK RECONSTRUCTION

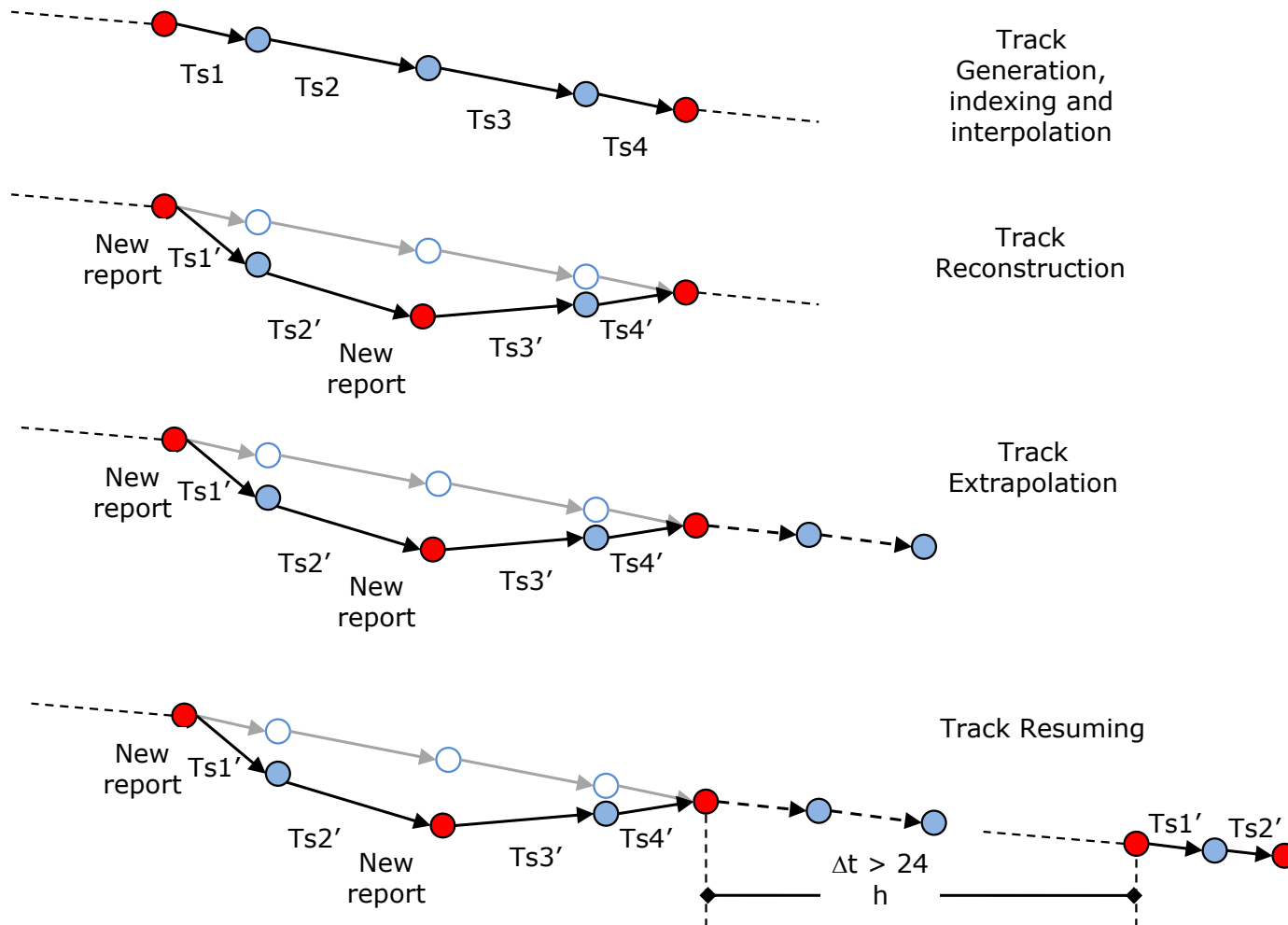
Track is the key entity. Three main elements are used:

- Reported → come from collaborative sensors
- Detected → come from EO-based detection systems
- Calculated → calculated to meet constraints and time grid



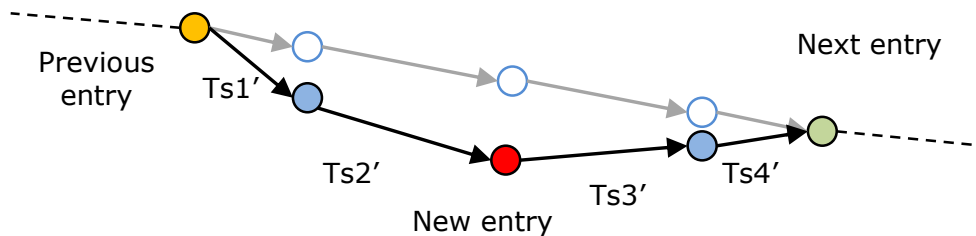
TRACK RECONSTRUCTION

Different functions are used:

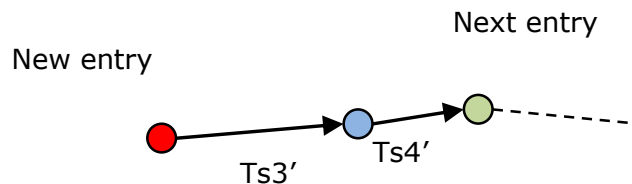


TRACK RECONSTRUCTION

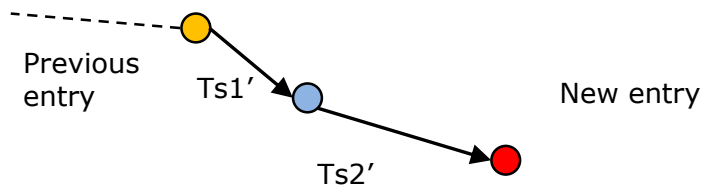
Different functions are used: Track Interpolation



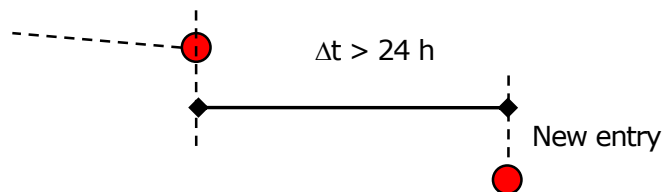
Nominal Track Scenario in fuse Track



Track Scenario with no previous entry in fuse Track



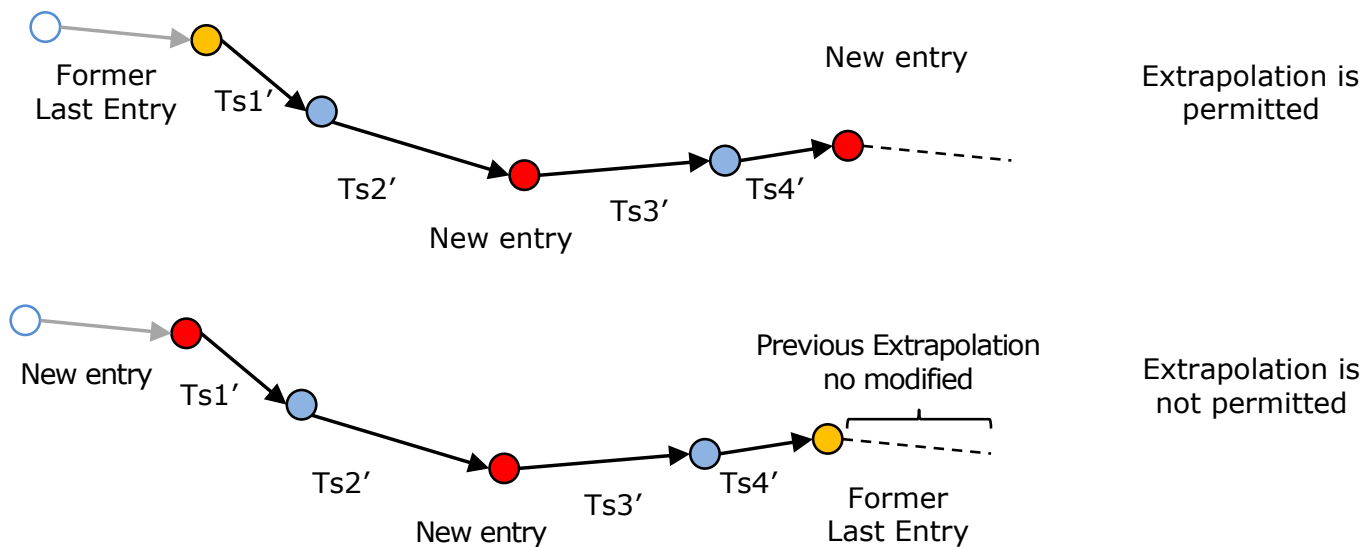
Track Scenario with no next entry in fuse Track



Track Scenario with no previous and next entry in fuse Track

TRACK RECONSTRUCTION

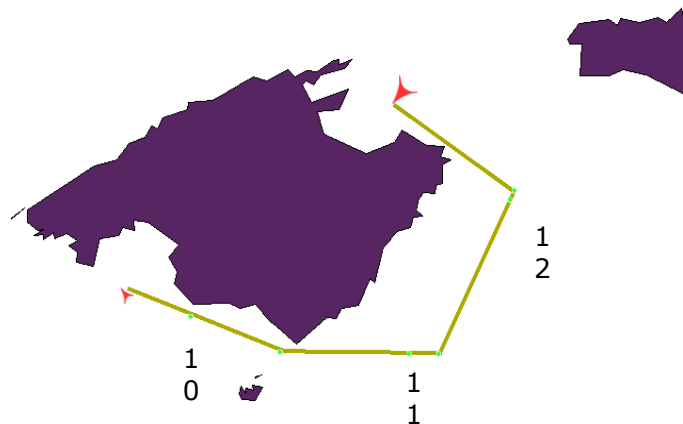
Different functions are used: Track Extrapolation



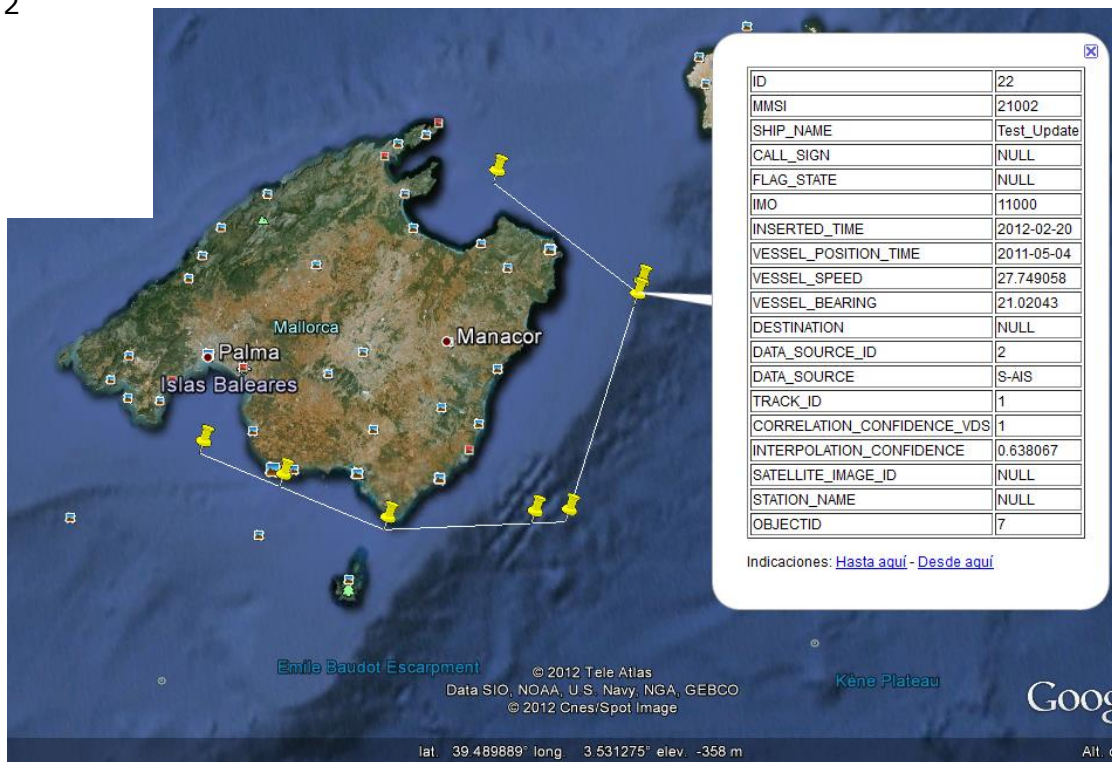
TRACK RECONSTRUCTION

Coastline avoidance

0 0.4 1 grados

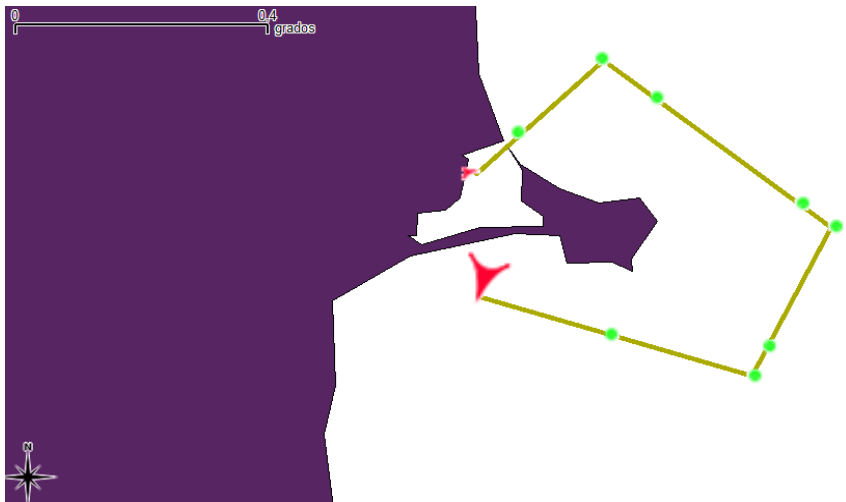


Generate tracks by avoiding land overlapping

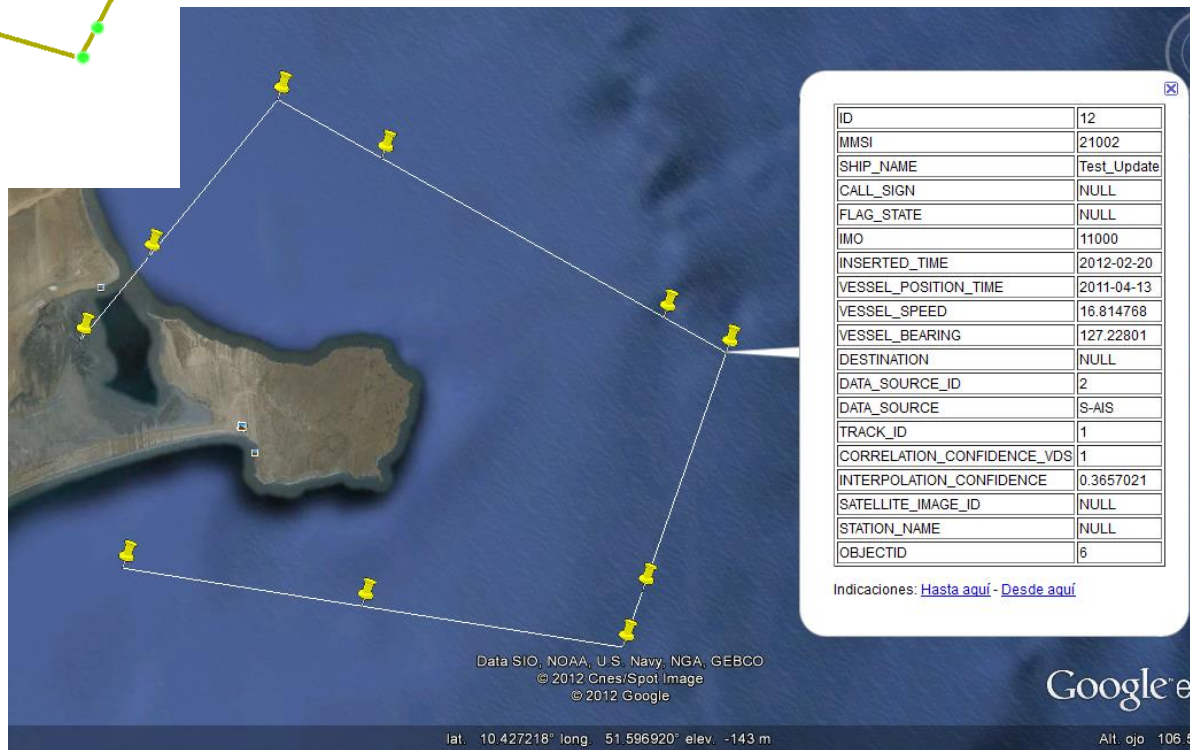


TRACK RECONSTRUCTION

Coastline avoidance

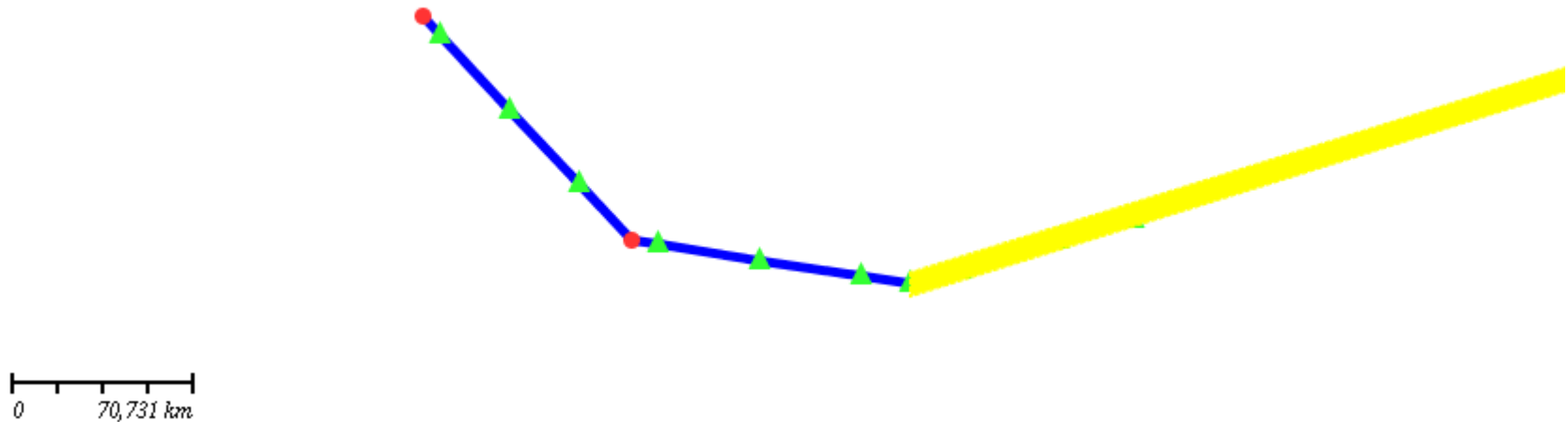


Generate tracks by avoiding land overlapping



TRACK RECONSTRUCTION

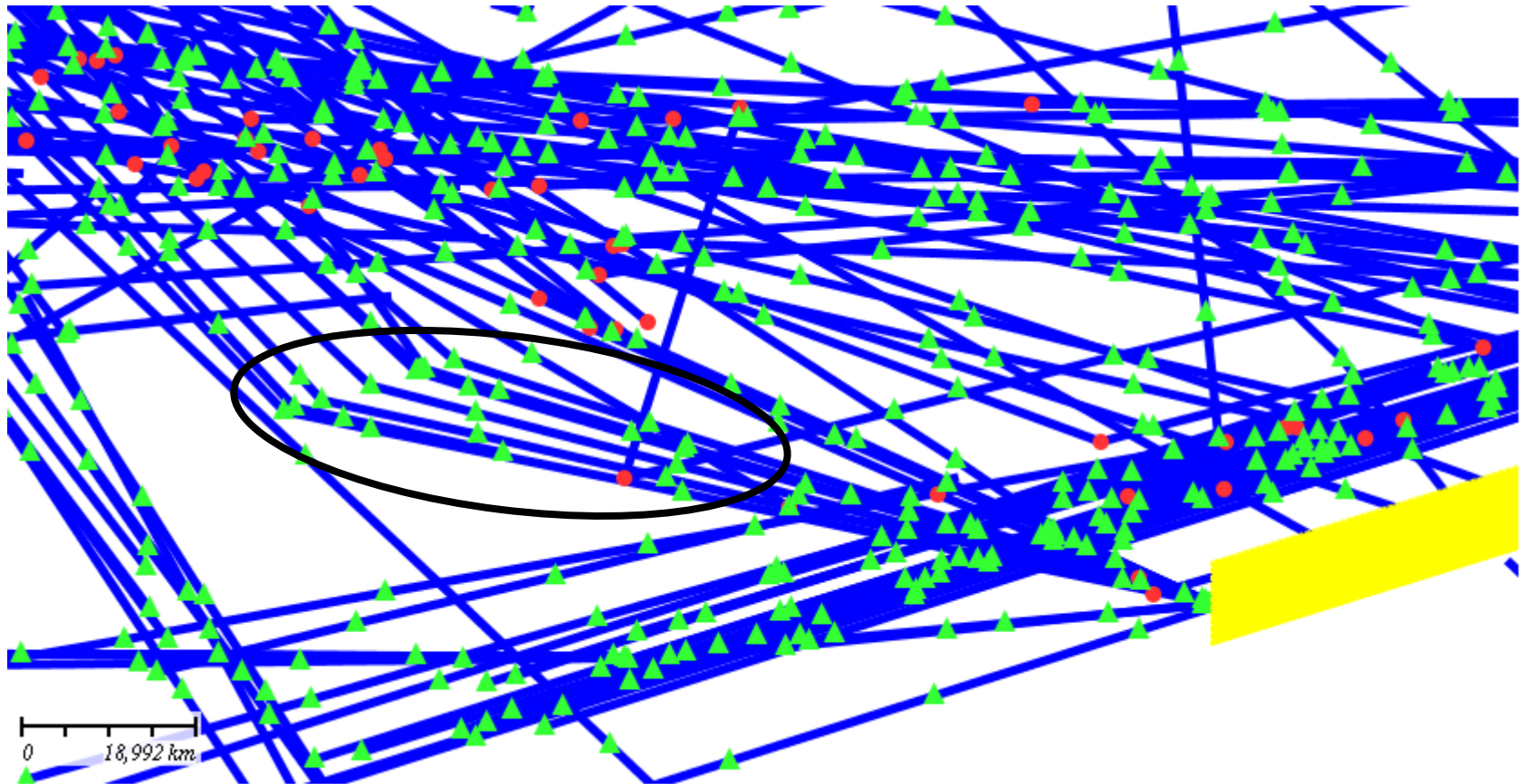
Corridor magnet effect



Mid-term track estimation
(route propagation) so
that it drives towards
specific areas, for instance
corridor lanes

TRACK RECONSTRUCTION

Corridor magnet effect

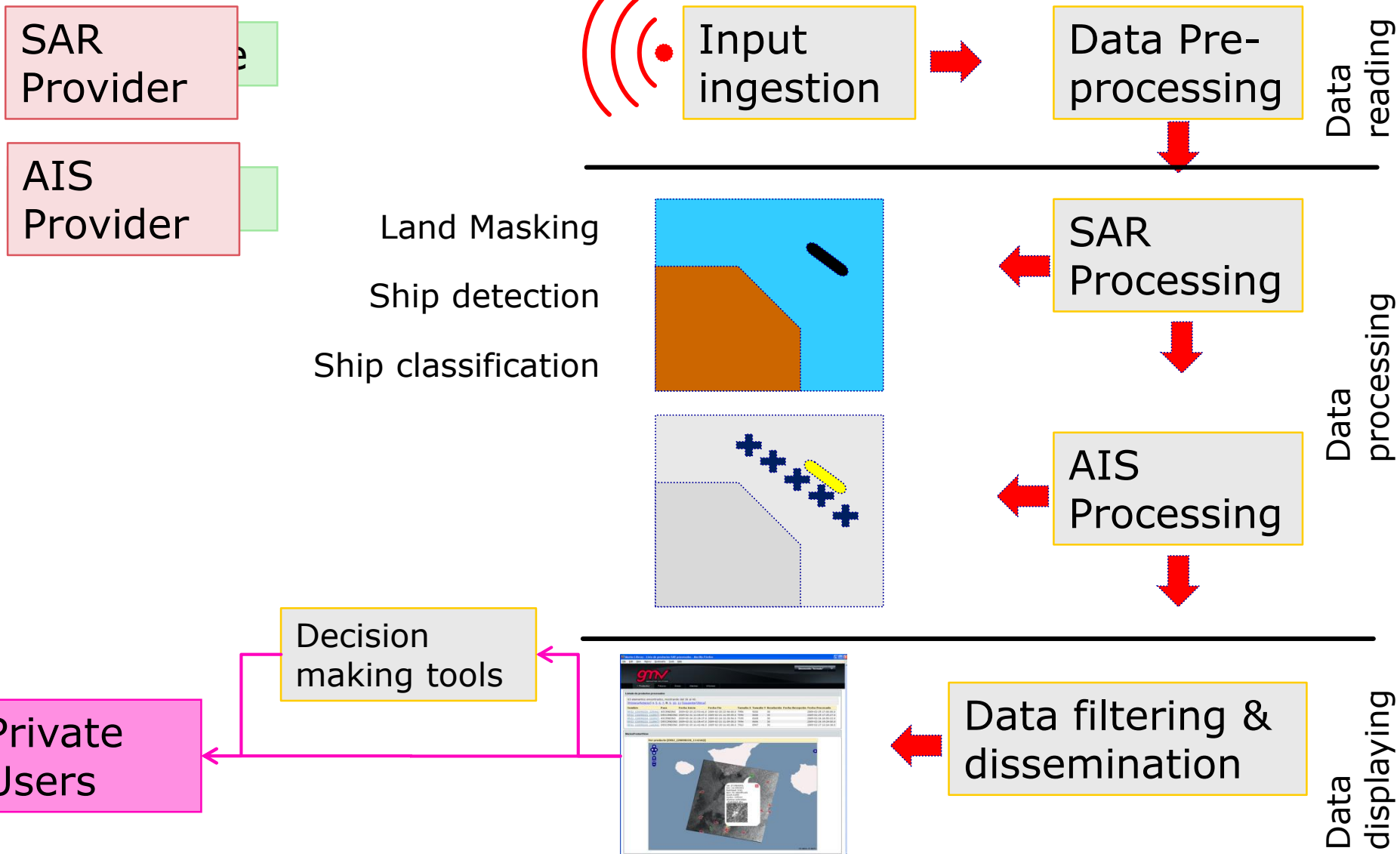


EO-based Maritime Applications Portfolio

VISUALIZATION SUPPORT

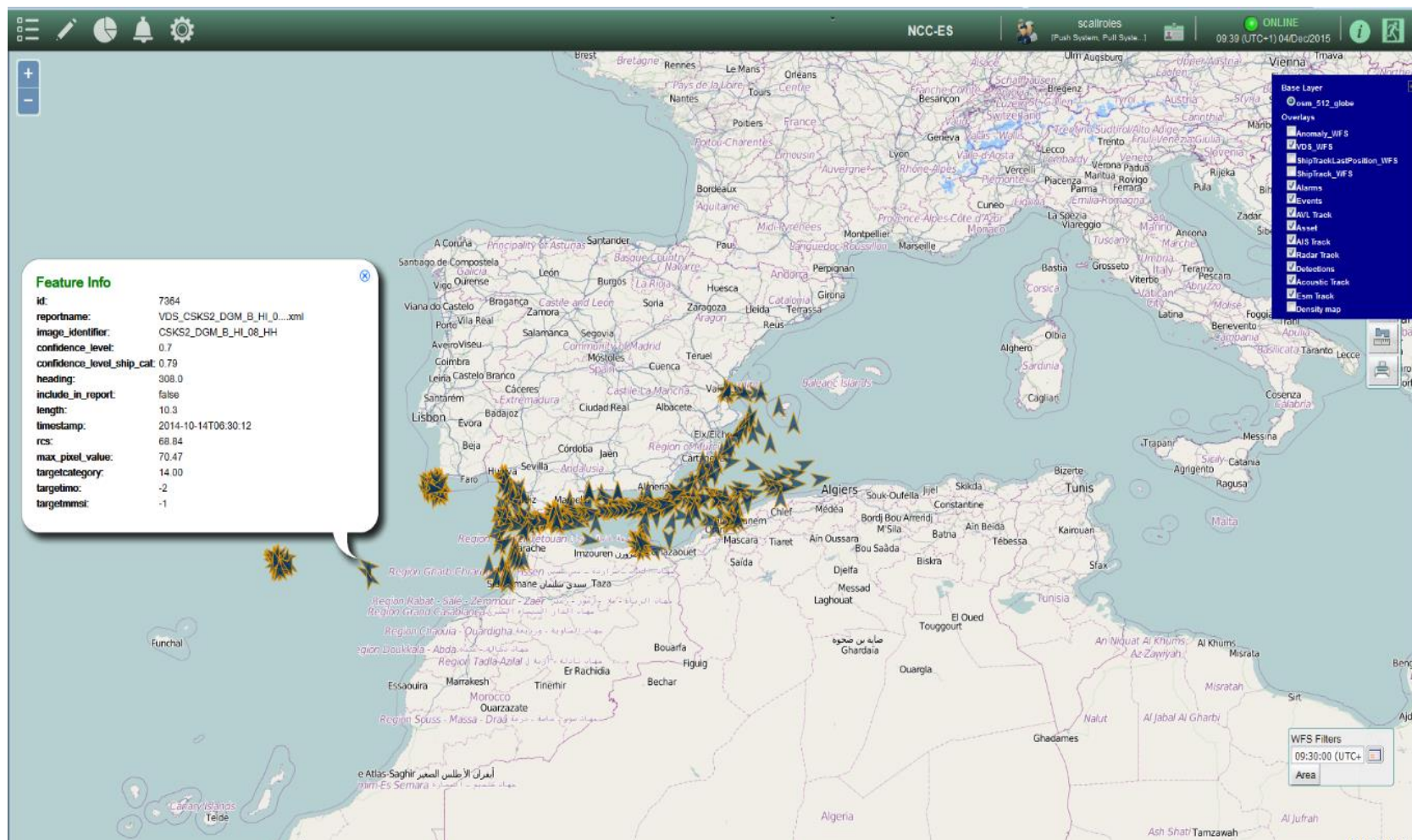


VISUALIZATION SUPPORT: V1



VISUALIZATION

Integration of a complete HMI suite with advanced functionalities



VISUALIZATION

Integration of a complete HMI suite with advanced functionalities

The image displays two screenshots of a CRVM (Crisis Response and Management) HMI interface. Both screenshots show a map of the Valencia region, Spain, with various geographical features and infrastructure. The interface includes a top navigation bar with the text 'NODE VALENCIA 01' and 'ONLINE 30/May/2014 11:25 (UTC+2)'. The left screenshot shows a detailed information popup for a ship named 'CENRED'. The popup contains the following information:

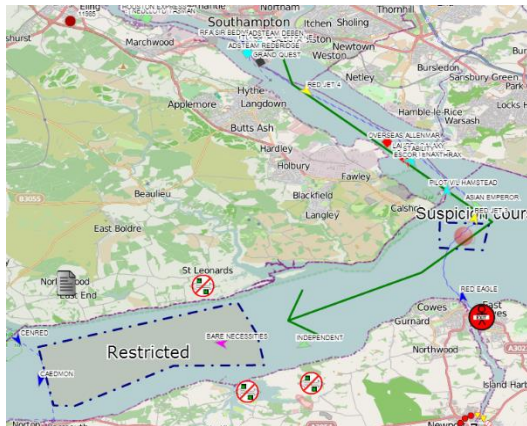
- IMO: 7324091
- Type: Passenger, all ships of this type
- Status: Under way using engine
- Flag: United Kingdom of Great Britain and Northern Ireland (GB)
- Destination: LYNNIS-YARM
- E.T.A.: 09:30 (UTC+2) 11/Sep/2014
- Location: [0°19'33"W,39°27'12"N]
- Updated: 11:14:00 (UTC+2) 30/May/2014
- Description: 000

The right screenshot shows the same map with an 'Incidents (49 items)' list overlay. The list contains the following items:

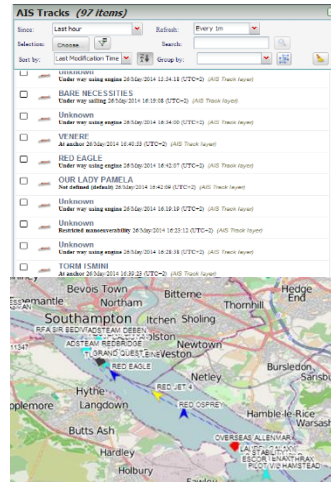
- Irregular exit [11:23:44 (UTC+2) 30/May/2014]
- Exploitation of prostitution of others [11:23:20 (UTC+2) 30/May/2014]
- Hashish [11:22:54 (UTC+2) 30/May/2014]
- Oil pollution [28:30:2014 17:33:07 (UTC+2) (Events layer)]
- Man-made fire [17:33:24 (UTC+2) 28/May/2014]
- Flood [17:32:28 (UTC+2) 28/May/2014]
- Wild fire [28:30:2014 17:32:27 (UTC+2) (Events layer)]
- Shooting Rookley [28:30:2014 17:31:31 (UTC+2) (Events layer)]
- Riots in Newport [28:30:2014 17:30:40 (UTC+2) (Events layer)]
- Document Falsification/Fraud [09:54:42 (UTC+2) 27/May/2014]
- Opium [09:55:37 (UTC+2) 27/May/2014]
- Amphetamine [09:55:23 (UTC+2) 27/May/2014]
- Other drugs [09:55:11 (UTC+2) 27/May/2014]
- Other drugs [09:54:56 (UTC+2) 27/May/2014]

VISUALIZATION

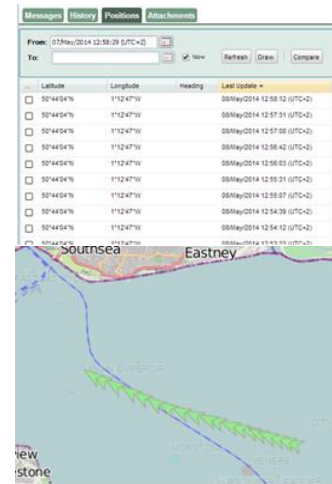
Integration of a complete HMI suite with advanced functionalities



Rule-based alarms & Anomaly handling



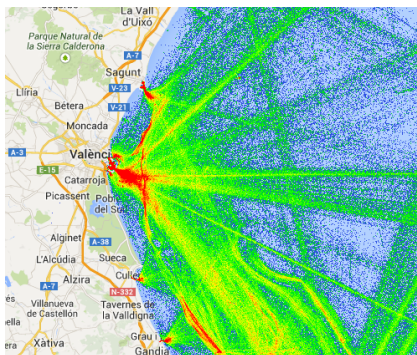
AIS track management



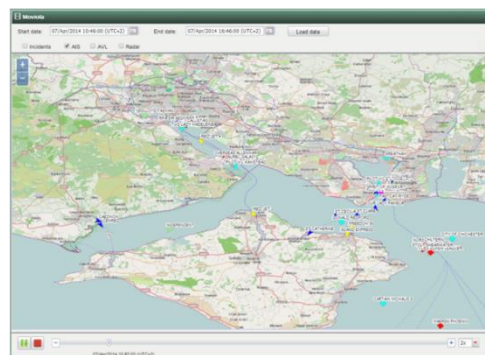
Historic queries



Alert handling



Statistics



Mission replay

GMV-IHI SIMONS

SIMONS

PERFORMANCE



SIMONS PERFORMANCE

SIMONS quality specifications

* Real length vs estimated length

** Real length vs estimated length with factorization of resolution cell

| Quality descriptor | Value |
|---------------------------|--|
| Processing Time | <ul style="list-style-type: none">• 5-6 min for a 40x40 km stripmap image• 7 min for a 10x10 km spotlight image• 10 min for a 100x100 km scansar image |
| Probability of Detection | > 95 % for ships with length > 4*image res. |
| Absolute Length accuracy* | ~75 % |
| Relative Length accuracy* | ~90 % |
| Categorization rate | ~70 % for ships with length > 12*image res. |
| AIS Fusion | Yes → large range of formats admitted |
| Band restrictions | No → any band and sensor is admitted |
| Area restrictions | No → any area (coastal, harbour, open sea...) can be processed |

SIMONS ALGORITHM DETAILS

- SAR detection algorithm → Wavelet Transform (WT) + clustering
 - WT is used to enhance the ship response wrt to sea background
 - Clustering is used to group the response of WT
 - High efficiency on detecting small targets
 - A detection confidence parameter is computed from WT parameters
- SAR categorization algorithm → Geodesic Active Contours (GAC) + Fuzzy Logic (FL)
 - GAC is used to delineate the ship SAR signature wrt to sea background
 - FL to evaluate the rule bank and provide a confidence parameter
- Data fusion → Any data can be fused
 - AIS (TAIS, SAIS) vs VDS is fused by using FL and a specific rule bank
 - If available, LRIT and VMS can be integrated as well
 - Route propagation and track reconstruction functions available
 - In-situ ship information (GPS, classic radar reports) can be integrated as well
- Optic processing chain → Available
 - Automatic ship detection chain (manual supervision recommended)
 - Manual ship categorization chain
 - Panchromatic images



Thank you

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